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MAPS OF THE TERRITORY INCLUDED WITHIN THE STATE OF MARYLAND, ESPECIALLY THE VICINITY OF BALTIMORE.

BY PROFESSOR GEORGE H. WILLIAMS.

WITH AN INTRODUCTORY NOTE BY PRESIDENT GILMAN.

INTRODUCTORY NOTE.

The Johns Hopkins University, since its organization, has endeavored (so far as the means at its command and the other duties required from members of its faculty would permit) to study the region in which the University is placed, and to give to the public the results of its studies. The region in its narrowest sense means Baltimore,—but as it is here interpreted it means Maryland, and in a still broader sense the upper portion of the territory which is drained by the Patapsco, the Potomac, the Gunpowder and other streams that flow into the Chesapeake Bay. One of the earliest steps to be taken was in recognition of the value of a good map of the region. Accordingly the head of the United States Coast and Geodetic Survey, Professor Julius E. Hilgard, by invitation of the Trustees, delivered in the Winter of 1876–7 a course of twenty lectures upon the principles and methods of topographical surveys, leading up to the study of Baltimore and its vicinity. To illustrate what might be done on a larger scale he prepared and exhibited a model in relief of a portion of the city—Druid Hill Park, if the writer remembers correctly. The object of these lectures was to enlighten the public as to the importance of good maps, and to show how they might be secured. A few years later Dr. W. K. Brooks, one of the naturalists of the University, undertook to study the marine life of the Chesapeake. The Maryland Fish Commission and the United States Fish Commission, for a time, coöperated in this work, and the organization was consequently called the Chesapeake Zoölogical Laboratory, although the observations soon extended far beyond this bay. It was then that Dr. Brooks became especially interested in the study of the Oyster, and made those researches which are now widely known. His report was published by the State, and after the edition was exhausted a shorter and more popular story of the Oyster was published by the University. A printed study of the red-bellied Slider Terrapin, by Drs. Martin and Moale, was also published. Meanwhile the Naturalists' Field Club was organized by Professor Martin. It was made up partly of members of the University and partly of other students of nature, resident in Baltimore, most or all of whom were members of the Maryland Academy of Sciences. These gentlemen began to make collections of the minerals, and of the mammals, birds, fishes, insects and plants that grow in this region. They brought together many specimens, and Mr. Sollers, with the aid of Dr. Barton and others, undertook to make a complete flora of the region. The Field Club coöperated also in affixing labels to the trees in Druid Hill Park.

When Dr. G. H. Williams began his duties as geologist, he made a careful study of the interesting Gabbro region which lies to the west of the city, and published several papers which attracted the attention of geologists. Inspired by these researches, the Trustees encouraged these gentlemen to prepare an excursion map of the environs of Baltimore, so that all who are walking or driving in this vicinity might have a trustworthy guide to the streams, roads, heights, and landmarks of the neighborhood. Two editions of this map were quickly disposed of. It was more and more important that altitudes should be indicated on the local map, and at length the coöperation of the U. S. Geological Survey, under the direction of Major J. W. Powell, was secured, and the beautiful map lately given to the public was prepared under his direction by accomplished engineers and assistants. The map appears in two forms, hypsometrical, indicating the heights by contours, and geological, indicating the structure by colors. Two relief models in plaster of the region around Baltimore have been prepared on a large scale (4 inches to the mile) for the Real Estate Exchange and for the University. They measure 5½ by 4½ feet and give a graphic idea of the topography.

Still another attempt to study the natural characteristics of the State is made by the Weather Service, conducted at the Physical Laboratory under the joint auspices of the State of Maryland, the Government Weather Bureau, and the University. Coöperation is secured from intelligent and faithful observers in all parts of the State, and a monthly bulletin is published giving to the public the recorded results.

A book describing the natural resources of the State and its industries, with accounts of its various institutions, is now in preparation for the World's Fair Commission of Maryland.

Finally, in order that all who are interested in these important enquiries may know what data are at command, the following paper is now prepared by Professor Williams, to whom, and to Professor Clark, the grateful acknowledgments of the public are certainly due.

D. C. GILMAN.

PROFESSOR WILLIAMS ON MAPS OF MARYLAND.

Within the past few years so much has been done in the way of constructing accurate topographical and geological maps and relief models of various portions of Maryland's territory that, with a view of giving a general description of these new acquisitions, it has also seemed of interest to prepare a brief account of all the previous cartographic work carried on within the confines of the State. What is here recorded are maps containing the results of original surveys or such as offer the best and most reliable sources of present information. Thanks for assistance in collecting the material are due to Professor T. C. Mendenhall, Director of the U. S. Coast and Geodetic Survey; Mr. Henry Gannet, Chief Topographer U. S. Geological Survey; Mr. Henry Thompson, Mr. John W. M. Lee, Dr. Wm. Hand Browne, Professor P. R. Uhler, Professor Basil Sollers, Mr. A. B. Hoen, Mr. Wm. Lucas, Mr. B. H. Griswold, of Baltimore, and others.

The maps of Maryland* may be arranged as follows:

1. Maps of early explorers and settlers.
2. Surveys of boundaries.
3. Topographical and geological surveys authorized by the State.
4. Charts published by the U. S. Coast Survey.
5. Private surveys (railroads, canals, counties, etc.)
6. Recent work published or in preparation by the U. S. Geological Survey, the Johns Hopkins University, and the Maryland World's Fair Commission (1884–1893).

1. MAPS OF EARLY EXPLORERS AND SETTLERS.

The first map of this region was published in London, 1624, by *Capt. John Smith*, in his "General Historie of Virginia, New England and the Summer Isles." This has often been reproduced, notably in the facsimile edition of Smith's works (English Scholar's Library, Birmingham, 1884) and in Scharf's History of Maryland, Vol. I.

Smith, of course, gave the Chesapeake as a part of Virginia. The first map of this region as the province of Maryland is that published by *Lord Baltimore*, in his "Relation of Maryland," printed in London in 1635, with instructions to emigrants and accounts of the country calculated to attract settlers. This map is entitled "Noua Terrae-Mariae Tabula," and is interesting in still calling the Atlantic ocean "Mare orientalis." The map is reproduced in Sabin's facsimile of the "Relation," New York, 1865, and in De Jarnette's Report on the Boundary between Md. and Va., Richmond, 1873.

The most important of the early maps was, however, that made during the decade succeeding 1660 for Lord Baltimore by *Augustine Herman*,† and first published in 1670. (Facsimile H.) Herman was a remarkable character. Born at Prague, he was educated as an engineer, and came from Holland to New Amsterdam with the Dutch. Peter Stuyvesant sent him south to help settle a boundary dispute, and he arrived in Maryland in 1660. He was so pleased with this country that he determined to remain here, and proposed to Lord Baltimore to make for him a new map of his domains in return for a large tract of land at the head of the Bay in Cecil Co. This offer was accepted, and Herman named his estate Bohemia Manor, in honor of his birthplace.

Herman's map was engraved by Faithorne and published in London in four folio sheets. Its title is "Virginia and Maryland as it is planted and inhabited this present year 1670; surveyed and exactly drawne by the only labors and endeavors of Augustine Herman, Bohemiensis." It contains a fine portrait of Herman. Its scale is 12 English miles to the inch. It names eight Maryland counties as well as the rivers "Sassqnahana," "Bush," "Gunpowder," "Patapsko," "Seavorn," "Patuxen," and "Patowmeck." The idea then prevalent that the Appalachians formed the central ridge of the American continent finds expression on Herman's map as follows:

> "These mighty high and great Mountaines trenching N. E. and S. W. and W. S. W. is supposed to be the very middle Ridg of Northern America and the only naturall cause of the fiercenes and extreame stormy cold winds that comes N. W. from thence all over this Continent and makes frost. And as Indians report from the other side westward doe the Rivers take their originall issuing out into the west sea, especially first discovered a very great River called the Black Mincquaas River out of which above the Susquehana Fort . . . .
>
> "Certain it is that as the Spaniard is possessed of great Store of Mineralls at the other side of these mountaines the same Treasures they may in process of time afford also to us here on this side when occupyed which is Recomended to Posterity to Remember."

The following old maps of portions of Maryland and the adjacent territory deserve mention:

"Virginia, Maryland, Pennsylvania, East and West New Jersey," by *John Thornton* and *Will Fisher*, 1695 (?). Scale 1 inch = 9.18 miles. (Original H). Same, French ed., Amsterdam, n. d.

A Mariner's Chart of the Chesapeake, published 1732–3. Its title is, "To the Merchants of London, trading to Virginia and Maryland this mapp of the Bay of Chesepeack with the rivers Potomack, Patapsco and part of Chester is dedicated by *Walter Hoxton*." (Original H).

Map of Pennsylvania and Maryland, by *J. Senex*, London, 1736 (L).

Map of parts of Pennsylvania and Maryland, 1740 (L).

Map of the most Inhabited Part of Virginia, containing the whole Province of Maryland, with Part of Pensilvania, New Jersey, and North Carolina; drawn by *Joshua Fry* and *Peter Jefferson*, 1751; engraved by Th. Jefferys. 4 sheets, London. French edition, 1755.

Virginia, Marylandia, et Carolina, a *J. B. Homanno*, Norimbergae, n. d.

A map of Northern Virginia, Delaware, New Jersey, Southern Pennsylvania and Maryland, by *J. Dalrymple*. 2 folio sheets, London, Jan. 1, 1755. "From information collected on the spot and entered in his journal." (Original H).

"An ancient map of the Province of Maryland on vellum colored" is said to exist in the English Public Record Office (N. Y. *Nation*, Dec. 22, 1892) but no date is given.

General Map of the Middle British Colonies, by *Lewis Evans*, Philadelphia, 1755, 2d ed. (1st ed., 1749, contained only N. Y., N. J., and Del.), in Evans' "Analysis of a General Map of the Middle British Colonies in America," being No. 1 of his "Geographical, historical, political, philosophical, and mechanical essays," printed by B. Franklin, and reprinted in London, 1756 (map 27½ × 20½ inches, sometimes colored); also, London, 1771.

Map of British and French Dominions in N. A., by *J. Mitchell*, 1755.

Accurate Map of North America after Treaty of Paris, 1763, by *E. Bowen*.

Map of the Middle British Colonies by L. Evans, corrected and extended by *T. Pownall*, London (J. Almon), 1776.

General Map of the Middle British Colonies, corrected from Gov. Pownall's late map, London (Sayer and Bennett), 1776. Scale, 35 miles to the inch.

New and accurate Chart of the Bay of Chesapeake, by *A. Smith*, London (Sayer and Bennett), 1776 (L).

Bowles' New Pocket Map of Maryland, Virginia, etc., by *Lewis Evans*. London, n. d. (L).

Carte générale des Etats de Virginie, Maryland, Delaware, Pennsylvanie, Nouveau-Jersey, New York, etc., d'après la Carte de L. Evans et Th. Jefferys.

Map of the Country between Albemarle Sound and Lake Erie, including the whole of Maryland, Virginia, etc., engraved by *S. J. Neale*, London.

New map of the western parts of Virginia, Pennsylvania, Maryland and North Carolina, by *T. Hutchins* (in his Topographical account of these States). London, 1778. Two editions. (L).

Map of the State of Maryland and of the Federal Territory as also of the State of Delaware, by *Dennis Griffith*. 3 large sheets, Philadelphia (J. Vallance), 1795.

Same, 2d edition (J. Melish), Philadelphia, 1813.

State of Delaware, with the Eastern Shore of Maryland, by *John Churchman*.

Maryland und Delaware, von *D. F. Sotzmann*, 1797.

Map of the Head of Chesapeake Bay and the Susquehanna River, with a plan of the town of Havre de Grace, by *C. P. Hauducoeur*, 1799.

State of Maryland, engraved by *Samuel Evans* for Carey's American Edition of Guthrie's Geography. N. d. (L).

New Map of Georgia, Carolina, Virginia and Maryland. C. Trebout, Sc. New York. (L).

2. SURVEYS OF BOUNDARIES.

The legal boundaries of Maryland have from the earliest times been an object of dispute, nor has a final settlement yet been reached.

The line between Maryland and Pennsylvania was the object of one of the most famous surveys made in this country. After numerous controversies a deed was finally executed between the heirs of Wm. Penn and Lord Baltimore in 1732, stipulating that their boundary line should be drawn across the peninsula of Maryland from Cape Henlopen (wrongly located by the Penns 15 miles too far south!) and from its central point a meridian should be followed to a circle drawn with a twelve mile radius about New Castle, Del. From the tangent point this meridian was to be followed to a parallel of latitude fifteen miles south of the southern boundary of Philadelphia, and this parallel was to be the E. W. boundary between the two colonies. To this deed was attached a small map with the boundaries indicated in red, known as "Lord Baltimore's Map." This map was printed by Franklin.

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* The maps here mentioned have so far as possible been personally examined by the writer. Where they are rare, the following letters are appended to their titles to indicate where they may be seen: H. Md. Historical Society; P. Peabody Library; L. signifies titles furnished by Mr. J. W. M. Lee. Many of the older maps are given in the Catalogue of Maps and Charts in Harvard University, 1831 (Ebeling Collection), pp. 195, 196. Bulletin No. 19 of the Harv. University Library on the Kohl Collection of Maps, 1886, also contains other titles of old maps, some of which include parts of Maryland.

† Further information regarding Herman may be found in the N. Y. Geneal. and Biogr. Record, Vol. IX, 1878, p. 52; N. Y. Historical Collections, Vol. XVIII; "Ancient Families of Bohemia Manor," by C. P. Mallery, Del. Hist. Soc., 1888. "A Maryland Manor," by J. G. Wilson, Md. Hist. Soc. (Fund Publication 30), 1890. The Maryland Historical Society also possesses the MS. journal of Herman on the "First Foundation and Seating of Bohemia Manor," 1660.

After twenty-eight years of further controversy, a second and final deed was executed in 1760. In 1763 the Penns and Lord Baltimore secured the services of two London surveyors, Mason and Dixon, who, between Nov. 15, 1763, and Sept. 29, 1767, continued the survey as far west as Dunkard's Creek, within 36 miles of its western limit. Here they were stopped by Indians. The bounding parallel was fixed by this survey as N. 39° 43′ 26″, instead of 40°, as was stated in Lord Baltimore's original patent of 1632. Mason and Dixon's map, with the final award of the Joint Commission and their report on parchment, is in the Maryland Historical Society.[*]

The disagreement regarding the Maryland-Virginia boundary is as to whether it should follow the North or South Branch of the Potomac. The original charter of Maryland defined this boundary as extending along the south bank of the Potomac river to the fountain-head of whichever branch was the longer, and thence north by a meridian to the 40th parallel of latitude. Which branch was the longer was not for some time known, although it is distinctly shown on the map made by Col. Thos. Cresap as early as 1754. See "Report of the Committee on the Western Boundary of Maryland," 1890. (Maryland Historical Society Fund Publication No. 29.)

The De Jarnette Report on the Maryland-Virginia Boundary (1873) is accompanied by a volume of ten maps reproduced from originals in Europe.

3. Topographical and Geological Surveys Authorized by the State.

After Maryland became one of the states of the Union over fifty years elapsed before serious thought was given to a new survey of her territory.

In December 1832 the Maryland House of Delegates appointed a special committee to prepare a "Report relative to the Expediency of procuring a Map of the State." This report was printed at Annapolis in 1833 (8o, 10 pp.). As a result of this report the General Assembly passed a resolution appointing an engineer and a geologist "to make the necessary examinations preliminary to a general survey of the territory of the State." J. H. Alexander and J. T. Ducatel were appointed to these positions May 25th, 1833. Their "Report on the Projected Survey of the State of Maryland" was printed in Annapolis in 1834 (8o, 39 pp.).[†] It is dated December 27, 1833, and contains a preliminary sketch map of the State.

In consequence of this report the General Assembly passed an act arranging "to make a perfect and complete map of the State according to the plan and drawing," and Gov. Thomas appointed Alexander and Ducatel engineer and geologist to carry out its provisions.

This first geological survey of Maryland was continued till 1841. During this period annual reports were prepared by Professor Ducatel [‡] and published. The first three of these also contain topographical reports by Professor Alexander.[§] This most accomplished engineer and versatile man, however, found the State appropriation so inadequate for the thorough trigonometrical survey which he had in mind, that he recommended a postponement of the work until it could be undertaken in connection with the U. S. Coast and Geodetic Survey, whose director, Professor Hassler, was his warm personal friend.

The operations of the Coast Survey were being rapidly extended southward from New York, but before they reached Maryland waters the State survey had been discontinued. Professor Alexander did not therefore draw his salary as State Engineer, but during the early years of the survey he prepared an admirable topographical map of the State by compilation, and located upon it the boundaries of the geological formations and localities for the following useful mineral products: iron, chrome, copper ores; alum-clay and pyrite; potters' clay; soapstone and stone paint; granite, syenite and gneiss; marble, hydraulic limestone; slate, sandstone, coal. This map was never published in full size, but exists in two MS. copies beautifully executed by Alexander himself. One of these is in Annapolis and the other in possession of his son, Mr. J. J. Alexander, of Baltimore, to whose courtesy I am indebted for permission to examine it. This map is 6 ft. 7 in. by 3 ft. 5 in. Its scale is 1 : 200.000, with 50 ft. contour lines east, and 100 ft. contour lines west of the Monocacy river. A full list of authorities is given on the margin, together with ten profiles. The date of this map is not stated, but it must have been about 1836. It was published in much reduced form with Professor Ducatel's paper on the Physical Features of Maryland, in the Transactions of the Maryland Academy of Science, 1837. It was also published in part by counties in the Reports of the State Geologist as follows: Contour map of part of Eastern Shore and St. Mary's Co., Report for 1835; Hachure map of the Chesapeake between the Magothy and Patuxent rivers (1 : 150.000), and ditto of Dans Mt. (1 : 84.480) in Report for 1836; Hachure map of Cecil and part of Kent Cos. (1 : 150.000), and ditto of Montgomery Co. (1 : 120.000) in Report for 1837; Hachure map of Frederick Co. (1 : 200.000), and ditto of Baltimore, Harford, and part of Carroll Cos. (1 : 200.000) in Report for 1839; Hachure map of Washington and Allegany Cos. (1 : 200.000) in Report for 1840. This map of Alexander's was so much the best one extant during the war that shortly after the 19th of April, 1861, General Scott ordered Mr. Bates, of the Coast Survey, to have an exact tracing made of it. This was accordingly done in Mr. Alexander's house, and the tracing taken to Washington. Professor Alexander's last communication relative to the map of Maryland was a report on "The Trigonometrical Survey for the New Map," dated Feb. 2, 1841 (8o, 8 pp.). He states that the triangulation can shortly be commenced with the co-operation of the Coast Survey, but this was never done.

The two succeeding attempts of the State to have her natural resources systematically explored were directed by two so-called "State Agricultural Chemists," J. Higgins (1850–58) and P. T. Tyson (1860–62). Neither of these surveys ever contemplated the preparation of a new topographic map, although a new compilation was prepared on about the same scale as Alexander's map (1 : 200.000) by Aug. Faul for P. T. Tyson in 1860. The MS., which was never published, belongs to the Maryland Academy of Science and is at present preserved in the Peabody Library.

4. Operations of the U. S. Coast and Geodetic Survey.

The first really accurate survey of Maryland territory, based upon an elaborate system of triangulation, was made by the U. S. Coast and Geodetic Survey. At the request of the writer, Professor T. C. Mendenhall, the present Director, has very kindly had prepared by assistant J. W. Donn the following complete statement of all the operations of the Survey in Maryland, and especially those carried on in the immediate vicinity of Baltimore. This narrative is illustrated by a complete historic sequence of published charts and tracings of the triangulation in successive years. This material will be deposited in the library of this University.

U. S. Coast and Geodetic Survey Office,
Washington, D. C., *December 16th*, 1892.

Dr. T. C. Mendenhall,
Superintendent, U. S. Coast and Geodetic Survey.

Sir:—I have the honour to submit the following memoranda relative to the history of the Coast Survey operations in the vicinity of Baltimore, Maryland, giving dates of triangulation, successive charts, &c.

In the early years of the Coast Survey a topographical survey of Baltimore, incidental to that of the State of Maryland, became a subject of interest. A letter of Professor Hassler, the first Superintendent of the Coast Survey, date of January 7, 1834, to the Secretary of the Treasury, remarks: "It is proper for me to get more information upon the views of the survey of a map of the State of Maryland upon which Professor Ducatel had corresponded with me last summer." He writes under date of January 9: "In the course of last summer, Professor D. informed me that he and Mr. Alexander had been appointed by the Legislature of Md. to make a topographical map of the State and its junction with the Coast Survey."

In April, 1834, Professor Hassler, in another letter to the Secretary of the Treasury, writes: "Upon your favor of the 9th, relative to the junction of the survey of Maryland with the Coast Survey, authorizing me to make the proper arrangement to put the measure into execution, I shall make the appropriate agreement with Messrs. Ducatel and Alexander, combine with them and then give you details upon the plans agreed upon mutually."

Three months later Mr. Hassler reports to the Secretary the indefinite postponement of the proposed work, the Maryland committee not being ready to perform its part.

A period of ten years then elapses before any steps were taken for surveys in Baltimore or the Patapsco River.

Professor Hassler had in the meantime been succeeded by Professor A. D. Bache.

December 23, 1844, in Report of Professor Bache, mention is made of the beginning of the secondary triangulation in the Patapsco River under the direction of Assistant F. H. Gerdes. The triangulation in the near vicinity of Baltimore was done by Assistant

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[*] For the history of the Mason and Dixon Survey, with the controversies which led to it, see: J. Dunlop, "Mem. on the Controversy between W. Penn and Lord Baltimore," Penn. Hist. Soc., Mem. I, 1826. "History of the Mason and Dixon Line," by J. H. B. Latrobe, address before Pa. Hist. Soc., 1854; Philadelphia, 1855. "Mason and Dixon's Line—A History," by Jas. Veech, Pittsburg, 1857.

[†] Reprinted in the American Journal of Science (1 ser.), vol. 27, pp. 1–38, 1835.

[‡] See Biographical Notice by L. Agassiz, Am. Jour. Science (2 ser.), vol. 8, p. 146, 1849.

[§] See Memoir of Alexander by Bishop Pinkney, Md. Hist. Soc. Publication, 1867. Also another Memoir by J. E. Hilgard, read before the National Academy, April, 1872. Also J. D. Proud's "Notices of Deceased Alumni of St. John's College."

Ferguson, who determined the positions "Rosanne," five miles from the centre of the city, near the Old Frederick Road, and "Finley," several miles farther in a northeasterly direction.* These points were important factors in the several triangulations made in after years. Hydrographic work had not yet been begun. Topographical surveys were in progress in charge of Assistant Geo. D. Wise, at the entrance of the Patapsco River.

In his Report of December, 1845, Professor Bache states: "Materials for a chart of the Patapsco River and Baltimore Harbor will, it is confidently expected, be ready for use this winter, and the chart will at once be drawn and put in the hands of the engraver. The topography has been executed by Assistants Gerdes, Hassler, Wise, and Cutts. Sheets Nos. 6 and 8 are completed, and on No. 9 considerable progress made. No. 8 includes Baltimore City and adjacent country." Referring to sheet No. 8, Mr. Wise remarks: "Having found it impossible to reconcile the measured distance with a printed plan of the city (Poppleton's Map presumably), it was found necessary to make a detailed survey, especially of the part near the water."

During 1845 the hydrography of the Patapsco River and Baltimore Harbor was begun and completed. Topographical work was continued in the same localities during this year and 1846.

In 1847 engraving of the chart of the localities above named was begun.

In 1848 Magnetic observations were made at Fort McHenry.

Report of Professor Bache, December 27th, states: "Map of Baltimore Harbor and Patapsco River still in hands of engravers."

"During the year a verification † of the topography of the city of Baltimore was made by Assistant J. B. Gluck."

Report of November 5th, 1851, mentions: "Map of Baltimore Harbor, &c., still in hands of engravers."

During 1853 Assistant H. L. Whiting was engaged in verification * of topography of the Patapsco shores.

1854—A resurvey of part of the Patapsco River entrance was made by request of the Engineer Department, U. S. A.; no considerable changes were developed. With this the record of field operations by the Coast Survey in the vicinity of Baltimore, prior to the Civil War, closes.

In July, 1863, by request of the Military authorities at Baltimore, a topographical survey of the city and its approaches was begun. The triangulation, in charge of Sub-Assistant C. H. Boyd, based upon such data as could be availed of or discovered (the primary and secondary points of the work of 1844), was extended over the area designated. The points determined by Assistant Boyd included the following objects, whose identification at the present time is quite possible: "House of Refuge," "Mt. de Sales," "Druid Hill,' "Greenmount Cemetery," "St. John's," "Baltimore Cemetery," "Pious," (Rives Hill), and "Clifton." The topography was begun at the same time by Aid J. W. Donn. It was designed that the area of the survey should be limited to a circuit of four miles, with the Battle monument as the centre. The triangulation was completed during the summer and the topography advanced to the south along the principal roads. J. W Donn was succeeded by C. T. Iardella in this work in October. C. M. Bache was also assigned to a part of the survey in January, 1864. C. M. Bache advanced the work from Jones' Falls westward to a junction with the initial survey of J. W. Donn, while C. T. Iardella proceeded eastward of the Falls to Cross Keys village. C. M. Bache finished his work in September, having covered an area of 20.5 square miles. C. T. Iardella continued his work until the middle of 1865, the last part of it upon the south side of the Patapsco. The area surveyed was 30 square miles.

Hydrographic Survey of the Branches of the Lower Patapsco.

During the early summer of 1869 the following branches of the Patapsco River were surveyed by Assistant J. W. Donn: Curtis Creek and its branches, Stony Creek and its branches, Rock Creek, Bodkin Creek and its branches—all on the west side—and Bear Creek and its branches, North Point and Welshman's Creek on the east side.

Triangulation of 1866.

This work, by Assistant F. P. Webber, was carried over the Patapsco River from the entrance at Seven-foot Knoll to the city. One point, "Washington Monument," distant from the river and within the city limits, was included in his scheme. The points in his work were generally useful in harbor and river re-surveys, and comprises the following, many of which entered into succeeding schemes: "Monument," "Bayview Asylum," "Ft. McHenry flag-staff," "Lazaretto," "Buchanan," "Fishing Point," "Sollers' Point," "Hawkins' Point," "Ft. Carroll Light House," "Sparrows' Point," "Rock Point," "North Point," (upper light). "North Point," (lower light), "Bodkin," and "Seven-Foot Knoll Light House."

Survey of 1876.

The interest manifested by the Municipality of the City of Baltimore in regard to permanent improvements of the Harbor took form in May of this year. The Legislature of Maryland, in its session of 1875-76, passed a special appropriation of 5,000 dollars for the purpose of a proper topographical survey in furtherance of that purpose. The Bill provided for the co-operation of the Coast Survey in the work, and requested the appointment by the President of a Commission composed of the Chief of Engineers, the Superintendent of the Coast Survey, and the U. S. Engineer in charge of Harbor and River improvements at Baltimore.

This Commission, appointed as requested, consisted of Major Gen. A. A. Humphreys, Dr. C. P. Patterson, and Major W. P. Craighill. J. W. Donn, Assistant Coast Survey, was assigned to make all surveys needful for the deliberations of the Commission in the establishment of permanent harbor lines. These surveys were shown upon five sheets of wharf, pier and shore lines, and the same number included full hydrographic details.

For this special survey a careful triangulation was made during July and August, 1876. In the course of this triangulation the following easily recognized points and discoverable with little trouble at the present time, were determined: "Bayview Asylum," "Washington Monument," "Light Street Corner," "Gail & Ax's Cupola," "Malt House," "Knabe's Piano Factory," "Chase's Wharf," "Bonded Warehouse," "Abbott's Foundry," "Mill Cupola," "Central Cupola," "Green Cupola," "Elevator B," "Lazaretto," "Iron Foundry," "Parapet," and "Ft. McHenry flag-staff." Subsequently the entire wharf line was measured carefully with a steel tape as a check and for comparison with the plane-table determinations. As usual, the topographical work was done entirely upon the ground; the only record being delineations upon the field sheets. Comparisons were frequently made with the measured lines of wharves, piers and docks, and the agreement left nothing to be desired in point of accuracy.

In extending the survey along such parts of the shore as were not occupied by wharves or piers, and which could not be clearly defined otherwise, a leveling instrument was used to mark out the line of mean high water. This plane was ascertained by the observation of a series of day and night tides extending through two lunar months. Tide stations were established at Henderson's Wharf (Fell's Point), Woodall's Ship Yard (Locust Point), Bollman's Wharf (Canton), and at Winans' Dock in the Patapsco River. The series was recorded at the Fell's Point gauge, and during intervals free from winds and abnormal tides, simultaneous observations were made to determine differences of period of maximum of flood and ebb. These differences were found to be less than 15 minutes, or practically inappreciable in the limited tidal flow of the Harbor, which the mean of one hundred and fifteen tides shows to be 1.16 ft., or .04 ft. less than that established for the station at Fort Carroll. The sounding of the Harbor was begun early in October and continued without interruption until that part of the area known as Spring Garden was closed by ice.

During the progress of hydrographic work the shores of the Patapsco River on both sides were surveyed, scale 1 : 3600 (300 feet to the inch). The space between the head of the basin and the lines of Canton was mapped on the scale of 1 : 1800 (150 feet to the inch). The hydrographic survey covered the entire area above the line of the Lazaretto and Marine Hospital Wharf, excepting the main branch of the river above the Long Bridge. The area of the Basin and Harbor to the entrance at Fort McHenry was sounded and plotted on the scale of the topographical sheets that covered the same locality.

On June 1, 1877, the survey was resumed at Spring Garden and in the Patapsco (main branch) between the drawbridge and Brooklyn, west of the bridge.

The recorded details show that in the course of the survey 17,400 soundings were made and 1443 angles measured for determining the position of the boat while sounding in midwater. The positions at ends of lines were determined by the plane-table. Principal lines of soundings were run parallel to the meridian. Cross or check lines intersected them at right angles. Lines of levels were run between the tide gauges at Henderson's, Bollman's, and Woodall's, but no appreciable differences of plane were found. The same result was obtained by simultaneous observation of tide at the several stations mentioned.

This, the most thorough and elaborate survey hitherto made in and adjacent to the Harbor of Baltimore. is represented by five topographic and five hydrographic sheets.

In March, 1881, Mr. Charles Junken, U. S. Coast and Geodetic Survey, made a re-survey of that part of the Patapsco lying between Fort Carroll and the line of Marine Hospital Lazaretto.

Observations and Experiments by Mr. C. S. Peirce at Baltimore, Md., in 1880 *and* 1881.

Experiments were made to study the effect on the rate of chronometers, consequent upon the time of winding. Observations of the oscillation of a pendulum swinging on rollers were made to determine the effect on the time of oscillation. The decrement of the arc of oscillation during long and short swings was also studied and measures were made for the length of the pendulums employed. Some time was also devoted to comparing the length of the meter with the wave length of light.

Survey of 1886.

In June, 1886, at the request of Major N. H. Hutton, Engineer of the Harbor Board, the work of 1876 was supplemented by a verification of the triangulation and its adjustment to more recent computations made by the Computing Division of the Coast and Geodetic Survey Office of the triangulation of the Chesapeake Bay The purpose of Major Hutton's request, however, was the tracing upon the ground of the Port Warden line established by the Commission of 1876 and its connection with the triangulation in such a way that its identification could be secured by reference to established ground-marks. The Superintendent of the Coast and Geodetic Survey assigned to this work Assistant O. H. Tittman. Copies of the original plane-table sheets of the special survey of 1876 were in possession of the Harbor Board of Baltimore, and upon these were laid down the Port Warden line of the Harbor after due consultation with the Engineer of the Board. In conformity with the suggestions of Major Hutton, Mr. Tittman confined that part of his work to tracing the pier-head lines around the Harbor—the bulk-head lines in certain places only being marked.

The method pursued was to transfer the Port Warden line to the original sheets. These sheets were then taken into the field and in general the points of deflection of these lines were identified by means of the plane-table. They were then referred by distance measurements and deflection angles to stones planted in the streets or sidewalks of the city, except where no streets had been opened, as along the middle branch of the Patapsco River, where the stones were set along the high-water line. These stones were connected with the triangulation and their location accurately described in the records.

As a base for the needful triangulation, Assistant Tittman adopted the same line, Bayview-Monument, that had been used in 1876, and as the progress of the measurements between the reference stones in the streets disclosed a want of accord between the distances determined by these measurements and those deduced from the triangulation, it was deemed advisable to strengthen and check the triangulation by connecting it with some of the primary stations Finally, however, on account of the difficulties of recovering the stations proposed and the expense attending their occupation, it was decided to obtain the desired check by the measurement of a base line and its introduction into the triangulation. A site about a mile in length having been selected on Fort Avenue, the measurements were made with the four metre contact slide case apparatus and a correction found and applied to the previously accepted distance, Bayview-Monument. One hundred and seven geographical positions were determined, of which all but eleven were new.

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* Washington Monument was also determined during the same period.

† These verifications were in reality re-surveys.

In the scheme of triangulation carried out by Assistant Tittman, many points of the work of 1876 were included. Of the one hundred and eleven geographical positions determined, nearly all can be identified and made available for future surveys. The prominent new positions added to the previous lists are: "Grace Methodist Church Spire," "St. James' Church Spire," "Johns Hopkins Hospital," "City Hall," "Holy Cross Church Spire," and the "Canton Elevator."

At the end of March, 1887, Major Hutton applied for the assignment of an officer of the Survey to execute certain work supplementary to that accomplished by Assistant Tittman, and Sub-Assistant W. I. Vinal was assigned for that purpose. In connection with the soundings made, some miscellaneous measurements of streets and wharves along the water front were included in his work.

Survey of Sparrows' Point, 1891.

In May, 1891, a closely detailed topographical survey of the locality of the works of the Maryland Steel Company at Sparrows' Point, Patapsco River, and the hydrographic survey of its water front to the Baltimore ship channel, and Bear Creek to the railroad bridge, were made by Assistant J. W. Donn.

The following supplementary report shows in a partly tabulated form the work of the Coast Survey in the State of Maryland and District of Columbia between the years 1832 and 1892.

Triangulation.

In 1844–45–46 the primary triangulation was carried across from the Delaware Bay to the head of the Chesapeake and down to the Kent Island Base-line, established during this period by Assistant Edward Blunt and James Ferguson. In the latter year the work was extended to the District of Columbia, and in 1847 had reached Point No Point and Hooper's Island. In 1848 the entrance of the Potomac River was included in the lines.

The secondary triangulation progressed with the primary, but incidental to topographic work was continued over the Chesapeake and its Maryland tributaries during the entire period closing with 1870

Primary triangulation was begun in 1864–65 by Assistant J. A. Sullivan, in Western Maryland, as a part of the trans-continental scheme. Afterward this was continued by Assistant C. O. Boutelle. At the present time the stations Maryland Heights and Sugar Loaf Mountain are connected with the work of Chesapeake Bay and the work passing over Western Virginia. The position of Rockville, Md., has also been determined as described by Assistant Edwin Smith, in Bulletin No. 25, which accompanies this record.

Astronomy.

Stations were established and observations made in 1844–45–46–47 at the following primary points. Osborne's River (head of Bush River), Taylor (near Severn River), Marriot (near West River), S. Base (Kent Island), Poole's Island.

Hypsometry.

Leveling operations between Annapolis, Md., and Washington, D. C., 1875, 1880, 1884, 1888. Appendix No. 15, Report for 1889, explanatory of this work, is submitted.

Topography.

The following is the list of all topographic surveys made within the limits of Maryland by the U. S. Coast and Geodetic Survey, with their scales, dates and surveyors:—

EASTERN SHORE.

Big and Little Annamessix Rivers, Vicinity of Crisfield, and entrance of Pocomoke River	1-20,000	John Seib R. D. Cutts S. A. Wainwright C. T. Iardella C. Junken	1849 1851 1851 1860 1872
Manokin River, Deal's Island, Vicinity of Holland Strait, Tangier Sound and Smith's Isl'd.	1-20,000	John Seib S. A. Wainwright	1849 1849
Money Bay, Wicomico River, Nanticoke River and Fishing Bay	1-20,000	John Seib S. A. Wainwright	1849 1849
Honga River, Tar Bay	1-20,000	R. D. Cutts John Seib	1848 1848
Little Choptank River and Taylor Island	1-20,000	G. D. Wise	1847
Choptank River	1-20,000	R. D. Cutts John Seib	1847–48 1847–48
Sharp's Island, Tilghman's Island, Poplar Island and Harris' Creek	1-20,000	G. D. Wise	1846–47
Meekin's Creek	1-20,000	H. L. Whiting	1854
Eastern Bay, St. Michael's River, Tredhaven Creek, Front and Back Wye Rivers	1-20,000	R. D. Cutts	1847
Outer Shore of Kent Island	1-10,000	H. L. Whiting	1844
Inner Shore of Kent Island	1-20,000	R. D. Cutts	1847
Chester River	1-20,000	J. C. Neilson	1846
Chester River entrance to Worton's Point, including Poole's Island	1-20,000	R. D. Cutts	1845
Worton's Point to mouth of Elk River	1-20,000	G. D. Wise	1845
Entrance of Sassafras River	1-20,000	H. L. Whiting	1854
Sassafras River	1-20,000	J. J. S. Hassler	1846
East side Elk River Entrance	1-20,000	J. Hull Adams	1860
Head of Elk River	1-20,000	T. W. Werner	1837
Elk River	1-20,000	J. J. S. Hassler	1843-45, 1855

WESTERN SHORE.

Point Lookout, St. Mary's, St. George's Rivers	1-20,000	R. D. Cutts J. Seib J. Hull Adams	1848 1848 1858–59
St. George's River		J. W. Donn	1868
Point No Point to Cove Point Light, and Patuxent River to St. Leonard's Creek	1-20,000	R. D. Cutts John Seib	1848 1848
Cove Point	1-20,000	John Seib	1854
Cove Point to Fishing Creek	1-20,000	J. J. S. Hassler	1847
Fishing Creek to West River	1-20,000	R. D. Cutts	1846
South River	1-20,000	J. D. Wise	1843
South River	1-20,000	H. L. Whiting	1855
Severn River	1-10,000	F. H. Gerdes	1844
Severn River to Railroad Bridge	1-10,000	J. W. Donn	1888
Naval Academy Reservation	1-5,000	J. W. Donn	1888
Magothy River to Bodkin Point	1-20,000	F. H. Gerdes	1845
Magothy River Entrance	1-20,000	G. D. Wise	1845–46
" " "		G. D. Wise	1847
" " "		H. L. Whiting	1851
" " "		J. B. Gluck	1855
Patapsco River Entrance to Middle River and lower part of Gunpowder and Bush Rivers	1-20,000	G. D. Wise	1846–47
Upper part of Gunpowder and Bush Rivers	1-20,000	R. D. Cutts	1845–46
Romney Creek to Spesutia Island	1-20,000	G. D. Wise	1845
Bush River to the Susquehanna River, in-shore Sheet	1-20,000	R. D. Cutts	1845–46
Susquehanna River to Port Deposit	1-10,000	R. D. Cutts	1845
Susquehanna River Entrance to head of North East River	1-10,000	J. J. S. Hassler	1844–45
North East River	1-10,000	J. J. S. Hassler	1844–45

POTOMAC RIVER.

Piney Point to Lower Cedar Point, Breton's Bay, St. Clement Bay and Wicomico River	1-10,000	J. W. Donn	1868
Blackistone Island		S. A. Wainwright	1860
Shore Line—Cobb Point to Swan Point (Military reconnaissance)	1-10,000	C. Hosmer	1862
Lower Cedar Point to Indian Head (Military reconnaissance)	1-10,000	I. Mechan H. L. Whiting A. W. Longfellow C. Hosmer	1862 1862 1862 1862
Indian Head to Oxen Creek (Military reconnaissance)	1-10,000	A. M. Harrison	1862
Fort Foote—Military Survey	1-5,000	A. M. Harrison	1863
Three Mile Margin around District of Columbia, south-east side—Military Survey	1-15,000	J. W. Donn	1863
East Side District of Columbia from Oxen Creek to East Corner	1-10,000	C. M. Bache	1865
N. E. Side of District of Columbia, Three Mile Margin (Military Surveys)		C. Ferguson J. Hull Adams	1863–64 1863–64
U. S. Naval Magazine	1-1,200	J. Hergesheimer	1874
Oxen Creek to Benning's Bridge, and from Arsenal to Chain Bridge	1-15,000	C. H. Boyd J. Hergesheimer	1862 1874
Aqueduct Bridge to Chain Bridge	1-2,500	C. Junken	1872
Site of New Naval Observatory	1-1,200	C. Junken F. C. Donn	1881 1881
Chain Bridge to Great Falls and North to Offutt's X Roads and South-east to Three Mile Margin along North-east Boundary of District of Columbia (Military Survey)	1-15,000	F. W. Donn	1881
Three Mile Margin along North-east Boundary of District of Columbia (Military Survey)	1-15,000	C. Rockwell J. W. Donn C. Ferguson	1861 1862 1863
Special Survey of the District of Columbia for general avenue and street extensions, grading, drainage and sewerage	1-4,800	J. W. Donn D. B. Wainwright W. C. Hodgkins J. A. Flemer	1880 to 1891

Hydrography.

Outer Shore from Delaware and Maryland Boundary to West End of Assateague Bay	S. P. Lee, U. S. N	1849–50
Battu Shoal	T. S. Phelps	1863
Inside Waters from Mitten Creek to Sinepuxent Bay	D. B. Wainwright	1887

CHESAPEAKE BAY.

Bloodworth Island to Cove Point	S. P. Lee, U. S. N	1848
Cove Point to Tilghman's Island	W. P. McArthur, U. S. N.	1848
Sandy Point to Poole's Island	G. N. Bache, U. S. N.	1845
Poole's Island to Old Woman's Gut	S. P. Lee	1846
Old Woman's Gut to Turkey Point	S. P. Lee	1846
Turkey Point Light to Havre de Grace Light	S. P. Lee	1846
Part of Pocomoke Sound	J. J. Almy, U. S. N	1855
Pocomoke River Entrance to Snow Hill	W. W. Harding	1869
Part of Tangier Sound	J. J. Almy	1856
Part of Tangier Sound	W. W. Harding	1869
Little Annamessix River and Crisfield Harbor	W. W. Harding	1868–69
Big Annamessix River Little Annamessix River Manokin Union Bay Wicomico River Ellis Bay	W. T. Muse, U. S. N	1858–59
Nanticoke River and Fishing Bay	W. P. Muse	1858
Little Choptank River	W. P. McArthur, U. S. N.	1848
Little Choptank River and Tributaries	W. W. Harding	1871
Choptank River Entrance	W. P. McArthur, U. S. N.	1848
From Light House to Wing's Landing and Tredhaven Creek Tributaries	R. Bache, U. S. N	1848
Choptank River, Wing's Landing, to Denton	W. W. Harding	1870
Choptank River and Tributaries	W. W. Harding	1871
Tredhaven Creek and Tributaries	W. W. Harding	1870

Harris', Porters' and Broad Creek	W. W. Harding	1870
St. Michael's River and Tributaries	W. W. Harding	1870
Eastern Bay, Wye and Miles Rivers	W. P. McArthur	1847
Eastern Bay, Wye and Miles Rivers	W. W. Harding	1870
Chester River Entrance	W. P. McArthur, U. S. N.	1847
Chester River to Chestertown.	W. P. McArthur, U. S. N.	1846
Chester River to Chestertown to Possum Point	W. W. Harding	1869–70
Chester River, Morgan's Creek from Bridge to Head of navigation	W. W. Harding	1870
Chester River, Possum Point to Crampton	W. W. Harding	1869–70
Langford, Fairlee, China, Stillpond and Lloyd's Creeks	W. W. Harding	1870
Sassafras River from Gum Point to Wilson's Wharf	W. P. McArthur, U. S. N.	1847
Sassafras River, Wilson's Wharf to Head and Tributaries	W. W. Harding	1870
Elk River from Turkey Point to Elks Landing	W. P. McArthur	1846
Bohemia River, Back Creek to North River	W. P. McArthur	1846
Susquehanna River from Spesutia Isl'd to Havre de Grace	F. P. Webber	1872
Romney Creek	W. W. Harding	1870
Havre de Grace Light to Silver Island	W. P. McArthur	1846
Bush, Gunpowder, Middle and Back Rivers	W. P. McArthur	1846
Patapsco River Entrance	R. Wainwright, U. S. N.	1854
Patapsco River Entrance	F. P. Webber	1866
Belvidere Shoal	A. Boedike	1882
Brewerton Channel	W. P. Webber	1866
Port of Baltimore	J. M. Bache, U. S. N.	1845
Creeks entering the Patapsco River	J. W. Donn	1869
Vicinity of Sparrows' Point and Bear Creek	J. W. Donn	1891
Sparrows' Point to Leading Point	C. H. McBlair	1852
Lazaretto Point to Hawkins' Point	C. Junken	1880
Baltimore Harbor and part of Patapsco River	G. M. Bache, U. S. N.	1845
Magothy River	G. M. Bache, U. S. N.	1845
Annapolis Roads	G. M. Bache, U. S. N.	1844
Annapolis Harbor and Roads	M. L. Wood, U. S. N.	[illegible]
Severn River, Head to Cedar Point	W. W. Harding	1870
Severn River to South River and Tributaries	W. W. Harding	1870
Patuxent River, Drum Point to Satterlies Point	S. P. Lee, U. S. N.	1848
Satterlies Point to Gods G. Point	W. T. Muse, U. S. N.	1857
Holland Point to Jones' Point	W. T. Muse, U. S. N.	1859
Potomac River, Cornfield Point to Piney Point	W. T. Muse, U. S. N.	1859–60
" " Piney Point to Blackiston's Island	W. T. Muse, U. S. N.	1860
" " Blackiston's Island to Cob Point	T. S. Phelps, U. S. N.	1862
" " Wicomico River, Breton's Bay		
" " St. Clement's Bay	J. W. Donn	1868–69
" " Cob Point to Mathias Point.	T. S. Phelps	1862
" " Lower Cedar Point, Whitehouse Point and Mathias Point	W. R. Palmer, U. S. N.	1862
Mathias Point to Metompkin P't and Port Tobacco River	T. S. Phelps, U. S. N.	1862
Metompkin Point to Shipping Point	T. S. Phelps, U. S. N.	1862
Shipping Point to Hallowing Point	T. S. Phelps, U. S. N.	1862–63
Hallowing Point to Ft. Washington.	T. S. Phelps, U. S. N.	1863
Fort Washington to Alexandria.	T. S. Phelps, U. S. N.	1863
Alexandria to Hunter's Point	C. P. Patterson	1862
Hunter's Point to Anacostia River	C. P. Patterson	1862
Potomac River, upper end of Washington Channel	E. E. Hasken	1891
" " Long Bridge to Aqueduct	C. P. Patterson	1862
" " Long Bridge to Analostau Island	C. Fendall	1867
" " Georgetown Water Front,	A. L. Marindin.	1890
" " Giesboro Point to Three Sisters Island	M. C. Ewing	1887
" " Georgetown to Little Falls	C. Junken	1872
" " St. Mary's River to Cornfield Point	W. T. Muse, U. S. N.	1857
" " St. Mary's River, Kits Point, to Head of Navigation	W. T. Muse, U. S. N.	1859
" " Anacostia River from Navy Yard Bridge to Benning's Bridge	A. Ballock	1865
" " Anacostia River, Benning's Bridge to Bladensburg	A. Ballock	1865

To complete this report of operations of the Coast Survey in Maryland, the maps of the Chesapeake Bay and the Potomac River are provided.

Respectfully submitted,
JOHN W. DONN,
Assistant Coast and Geodetic Survey.

With this report is presented the following maps and drawings, &c., illustrative of the historical record of the operations of the Coast Survey in and adjacent to the City and Harbor of Baltimore:—

	1 Tracing of the Triangulation of		1844, 1863, 1886.
	1 Tracing of the Triangulation of		1866.
	1 Tracing of the Triangulation of		1876.
No. 240.	1 Map of the Patapsco River, issued	1 : 60,000	1849.
" 721.	1 Map of the Patapsco River, issued	1 : 60,000	1859.
" 1134.	1 Map of the Patapsco River, issued	1 : 60,000	1870
" 1159.	1 Map of the Patapsco River, issued	1 : 60,000	1877.
" 136.	1 Map of the Patapsco River and Head of the Chesapeake Bay, issued	1 : 80,000	1877 (1883).
" 354.	1 Map of the Patapsco River issued	1 : 60,000	1892.
" 384.	1 Map of Baltimore Harbor, issued	1 : 10,000	1889.
" 384.	1 Map of Balto. Harbor, Sparrows' Pt., issued	1 : 40,000	1892.
" 376.	1 Map Delaware and Chesapeake Bays, issued	1 : 400,000	1892.
	1 Pamphlet Terrestrial Magnetism, Appendix No. 7, Report for 1888.		
	1 Pamphlet Terrestrial Magnetism, Appendix No. 11, Report for 1889.		

Charts.

No number,	Chesapeake Bay, Potomac River to Entrance Pocomoke Sound	1859.	No 385.	Annapolis Harbor	1889
No. 133.	Chesapeake Bay	1866.	" 386.	Patuxent River	1880
" 133.	" "	1872.	" 387.	" "	1881
" 133.	" "	1892.	" 388.	Potomac River	1868
" 134	" "	1862.	" 388.	" "	1877
" 134.	" "	1877.	" 389.	" "	1862
" 135.	" "	1872.	" 11 (389).	" "	1868
" 135.	" "	1877.	" 389.	" "	1877
" 135.	" " (Latest print.)	1877.	" 19 (390).	" "	1862
" 136.	" "	1861.	" 390.	" "	1882
" 136.	" "	1863.	" 391.	" "	1864
" 136.	" "	1872.	" 391.	" "	1875
			" 391.	" "	1883

One copy Appendix 15, Report of 1889.
One copy Bulletin No. 25.

5. Private Surveys.

As the population of Maryland increased it was natural that conditions should be constantly arising which called for more or less extensive and detailed private surveys. Such surveys have been made during the present century in great numbers. It is here necessary to mention only those which embraced considerable areas and included the results of new work. Detailed property surveys and maps which are purely compilations have been very frequently made, but these will not be considered.

The most energetic promoter of private surveys throughout the entire State was Mr. Simon J. Martenet, who died in November, 1892, at the age of sixty. He succeeded to the business of Thomas P. Chiffelle, City Surveyor, in 1855, and at once began the preparation of a new map of the State. This was carried on by counties. It was not based on a triangulation of the area, but it nevertheless resulted in the collection of much new information. This survey was carried on between 1857 and 1865, when the first edition of the State map was published, although various county maps had been issued previously.

The private surveys may be arranged under four heads:—

1. State Maps.
2. County Maps.
3. City Maps.
4. Railroad and Water Supply Maps.

The titles of the most important of these maps are here given, with the dates of their appearance.

State Maps.

Chart of Chesapeake and Delaware Bays, by *Fielding Lucas, Jr.*, 1832.
Small map of Maryland and Virginia, by *Fielding Lucas, Jr.*, 1836.
Map of Maryland constructed from the best authorities, by *Fielding Lucas, Jr.* 1852. (Nearly 6 miles to the inch.)
Map of Maryland, atlas and wall editions, by *S. J. Martenet.* 1865 (P).
New Topographical Atlas of Maryland by *Martenet, Walling* and *Gray*, with historical, scientific and statistical descriptions, and map of the U. S. Geological map of the State, with sections by P. T. Tyson, Zoölogy by Cope, and Climatology, with map, by L. Blodget. Baltimore, 1873.
Map of Maryland, with parts of Pennsylvania, Virginia, West Virginia and Delaware, by *Simon Martenet* from new surveys, 1857-1865. (3½ miles to the inch.) Last ed., 1886.
Outline and drainage map of the State, drawn by U. S. Geological Survey for Maryland Weather Service. 8 miles = 1 inch. 1892.

County Maps.

Map of City and County of Baltimore from original surveys by *J. C. Sidney* and *J. P. Browne*, 1851. 1 mile = 1 inch.
Ditto from actual surveys, by *Robt. Taylor*, 1857. 1 mile = 1½ inch. (P).
Map of Howard County, by *Simon Martenet*, 1858. 1 mile = 1½ inch.
Map of Cecil County, by *Simon Martenet*, 1858. 1 mile = 1½ inch.
Map of Harford County, by *Simon Martenet*, 1878. 1 mile = 1¼ inch.
Map of Carroll County, by *Simon Martenet*, 1862. 1 mile = 1½ inch.
Map of Kent County, by *Simon Martenet*, 1860. Scale, 1 mile = 1 inch.
Map of Montgomery County, by *Simon Martenet*, 1865. Scale 1 mile = 1 inch.
Map of Anne Arundel County, by *Simon Martenet*, 1860.
Map of Allegany and Garrett Counties, by *S. Martenet*, 1864 1 mile = 1¼ inch. MS. never published.
Map of Frederick County, by *Isaac Bond*, 1858. 1 mile = 1 inch.
Map of Caroline County, by *Isler*.
Map of Queen Anne County, by *Strong*.
Atlas of Baltimore County, by *G. M. Hopkins*, Philadelphia, 1877.
Atlas of Howard County, by *G. M. Hopkins*, Philadelphia, 1878.
Atlas of Montgomery County, including Prince George's County, by *G. M. Hopkins*, Philadelphia, 1879.
Atlas of Anne Arundel County, by *G. M. Hopkins*, Philadelphia, 1878.

Atlas of Frederick County, by *J. D. Luke*, (C. O. Titus & Co.), Philadelphia, 1873.
Atlas of Carroll County, by *Lake*, *Griffing* and *Stevenson*, Philadelphia, 1877.
Atlas of Washington County, by *Lake*, *Griffing* and *Stevenson*, Philadelphia, 1877.
Atlas of Wicomico, Somerset, and Worcester Counties, by *Lake*, *Griffing* and *Stevenson*, Philadelphia, 1877.
Atlas of Kent and Queen Anne Counties, by *Lake*, *Griffing* and *Stevenson*, 1877.
Atlas of Talbot and Dorchester Counties, by *Lake*, *Griffing* and *Stevenson*, 1877.
Atlas of Cecil County.

City Maps.

Exact Plat of Baltimore town (MS.), 1756. Framed (H).
Plan of Baltimore, by *G. G. Presbury* (MS.), 1780. Framed (H).
Plan of Baltimore and Environs, by *A. P. Folie*, 1792. Framed (H).
Plan of Baltimore (printed), 1799. Framed (H).
Plan of City and Environs, by *Warner* and *Hanna*, 1801. Framed (H).*
Plan of Baltimore, by *I. H. Poppleton*, under Commission of General Assembly, February, 1818.
Same corrected to 1851 (Nov.). (Hoen lith.)
Map of Baltimore, 100 perches = $1\frac{1}{4}$ inches, by *Fielding Lucas, Jr.*, 1822.
Scott's Map of the City of Baltimore, from Surveys by *Martenet*. 500 ft. = 1 inch. 1856.
Map of Baltimore and Vicinity, by *E. Robinson*, 1882. (84 Nassau St., N. Y.)
Atlas of Baltimore and its Environs, 2 vols., 800 feet = 1 in., by *G. M. Hopkins*, 1876–77.
Atlas of Baltimore, Md., by *G. W.* and *W. S. Bromley*, 2 vols., 1885. (Incomplete.)
Index Map of Baltimore, by *Jos. Rippey*. 500 ft. = 1 inch. New York, 1888.

Railroad Maps.

Map and Profile of the location of the B. & O. R. R. from Cumberland to Wheeling, with routes surveyed from 1835 to its establishment in 1850, B. H. Latrobe engineer. (Lith. Hoen.) (P).
Map of the B. & O. R. R., with its branches and connections, also Profiles. 6 miles = 1 inch. 1867, wall map. (P).
Many special Maps in the various Annual Reports of the B. & O. R. R., commencing 1827.
Map of the several surveys for the W. M. R. R., by G. P. Worcester, engineer. 3 miles = 1 inch. n. d. (Hoen lith.) (P).
Contour Maps of the South Mountain and Blue Ridge, from U. S. Geological and Pa. surveys. 100 ft. contour lines. 2 scales, issued by W. M. R. R., about 1 : 100,000, and 1 : 200,000. 1885.
Maps in 1st and 2d Annual Reports of Metropolitan Railway (Metropolitan Branch of B. & O.), 1854–55, of parts of Montgomery County.

Water Surveys.

Map of the Country through which a Canal to connect the waters of the Chesapeake and Ohio is proposed to pass and of the National Road between Cumberland and Wheeling, with the adjacent Country, from actual Survey by *Jas. Shriver*. (In Shriver's Account of Surveys Relative to the C. & O. Canal, Baltimore, 1824.)
Map of Baltimore City and part of Baltimore County, including the Valley of the Great Gunpowder River, from Warren Factory to tide, from surveys made in accordance with Resolution of Mayor and City Council of Baltimore, May 11, 1882. Lith. by Hoen. Scale, 200 ft. to inch; vertical, 250 ft. to inch. (P.)
Plan of Baltimore and Vicinity, showing proposed routes for bringing water from Jones', Gwynn's Falls, and Patapsco River, directed by James Slade, 1853. $2\frac{5}{8}$ inches = 1 mile. (P).

6. RECENT TOPOGRAPHIC WORK.

The recent cartographic work, which has provided Maryland with a new and reliable topographic map of so large a portion of her territory, has been carried on by the United States Geological Survey, with the use, of course, of all the data previously collected by the Coast and Geodetic Survey.

In 1879 an act of Congress consolidated the four great geological surveys of the public domain in the west into one organization, and three years later this organization, known as the U. S. Geological Survey, was authorized to construct a geological map of the United States. This provision was interpreted to imply the preparation of topographic maps as a base, and to allow the extension of the work into all parts of the United States. Topographical surveys were at once begun at various points in the Appalachians,—among others at Cumberland, Md. The account of the operations of the field parties may be found in the successive Annual Reports of the Director of the Geological Survey. In 1883 a party under the direction of Mr. S. H. Bodfish, and later of Mr. W. T. Griswold, surveyed that portion of Maryland west of Cumberland, with adjacent parts of West Virginia. The next year Mr. Griswold continued the work eastward, through Allegany and Washington Counties, Md., and in adjoining parts of Virginia and West Virginia. These maps were made on the scale 1 : 125,000, or about two miles to the inch. The contour lines had a 100-foot interval.

In the summer of 1885 the first topographic work on a one inch to the mile scale (1 : 62,000) was begun in Maryland, when Messrs. Hoffman and Havell surveyed two $\frac{1}{16}$ degree sheets in the neighborhood of Washington. The contour interval for these more detailed maps is 20 feet.

During the summer of 1887 Mr. Sumner H. Bodfish was sent to make a map of the neighborhood of Baltimore on the same scale. He completed a $\frac{1}{16}$ degree sheet (about 220 square miles), with the city of Baltimore in its centre, of which he published an account in the *University Circulars*, No. 65, p. 72, for April, 1888. In the same season the area in Virginia south of the Potomac and east of Great Falls was surveyed by Mr. Barnard on a two mile to the inch scale, with 50 ft. contours, and the portions of Maryland lying on the other side of the river were mapped in the same way the next season (1888) by Mr. Harrison. During the summers of 1888 and 1889 Mr. Hackett surveyed, on the same scale, the area in Maryland between Catoctin Mountain and Hood's Mills, as far north as parallel 39° 30′.

In the seasons of 1890 and 1891 Mr. A. E. Murlin completed the survey of Southern Maryland, comprising a strip lying between meridians 76° 15′ and 77°, and parallels 39° 30′ and 38°, on a scale of one mile to the inch, with 20 ft. contour lines. This area, which includes about four thousand square miles, could be mapped in so short a time because of the work already done in it by the Coast Survey along the Chesapeake and Potomac, by Hofman near Washington, and by Bodfish near Baltimore, and because of the comparatively flat and simple character of the country.

As a result of the topographic work of the U. S. Geological Survey between the years 1883 and 1891, all the area of Maryland has been surveyed except the Eastern Shore and a strip 13′ 28″ wide, lying between parallels 39° 30′ and the Mason and Dixon line, which extends from Emmittsburg eastward to the Delaware line (15½ by 80 miles). The territory already mapped is divided as follows upon the Geological Survey Atlas Sheets of the United States: Territory west of meridian 77° 30′ (Catoctin Mountain), on scale of two miles to the inch (1 : 125,000), with 100 ft. contours. Of this the area north of parallel 39° 30′ is drawn and the drawing photographed, but not yet engraved; the areas of Maryland south of this parallel form parts of the four published atlas sheets of North Virginia—"Piedmont," "Romney," "Winchester," and "Harper's Ferry." East of meridian 77° 30′ is a north-south row of three published atlas sheets, also on the scale 1 : 125,000, but with 50 ft. contour lines. These are called "Frederick," "Mt. Vernon," and "Fredericksburg." The north-eastern quarter of the Mt. Vernon sheet has also been surveyed on the one mile scale—1 : 62,500, with 20 ft. contour lines, and published separately as the "West Washington" sheet. This same scale has also been employed for all the territory thus far surveyed to the east, and published three north-south rows of six sheets each.

There are therefore now extant, beside some very important photographs of unpublished maps, six ½ degree (the Winchester sheet does not include any part of Maryland), and eighteen $\frac{1}{16}$ degree atlas sheets, which are occupied wholly or in part with Maryland's territory. The accompanying map shows the portions of the State included in the new survey and also the boundaries and names of the different atlas sheets.

Several States, like New Jersey, Massachusetts, Connecticut, Rhode Island and New York, have secured or are securing complete topographical surveys of their territory through appropriations to cover one-half of the expense of the map. Maryland has, however, obtained a new survey of so large a proportion of her area without the expenditure of one dollar of State funds.

The recent topographic work in Maryland by the U. S. Geological Survey has supplied a long-felt want for a reliable map, especially in the neighborhood of Baltimore. It is therefore not surprising that this data should be put to a variety of uses and give rise to several different representations of the country. The chief agents in the rapid application of the survey results have been the Johns Hopkins University and the World's Columbian Exhibition.

The need of a map of the vicinity of Baltimore has long been felt by the students of the University. An attempt was made to supply this need in 1884 by the compilation of a road map, under the editorship of Mr. A. L. Webster, then a student here. A drawing was made by Mr. Louis Nell, of Washington, of a region twenty-five miles square with Baltimore at its centre, on a scale of two inches to the mile. This was published by the University on a scale of approximately one mile to the inch, and served so good a purpose that a second edition was issued, with corrections, in 1887. This map has been known as the "University Field Club Map," since it was designed primarily to stimulate the study of the natural features of the Baltimore region. The greatest lack of this map was the absence of all topographic data. In 1887 the University had prepared by Mr. L. Sandoz, of Princeton, a large wall map of the physical features of the Chesapeake

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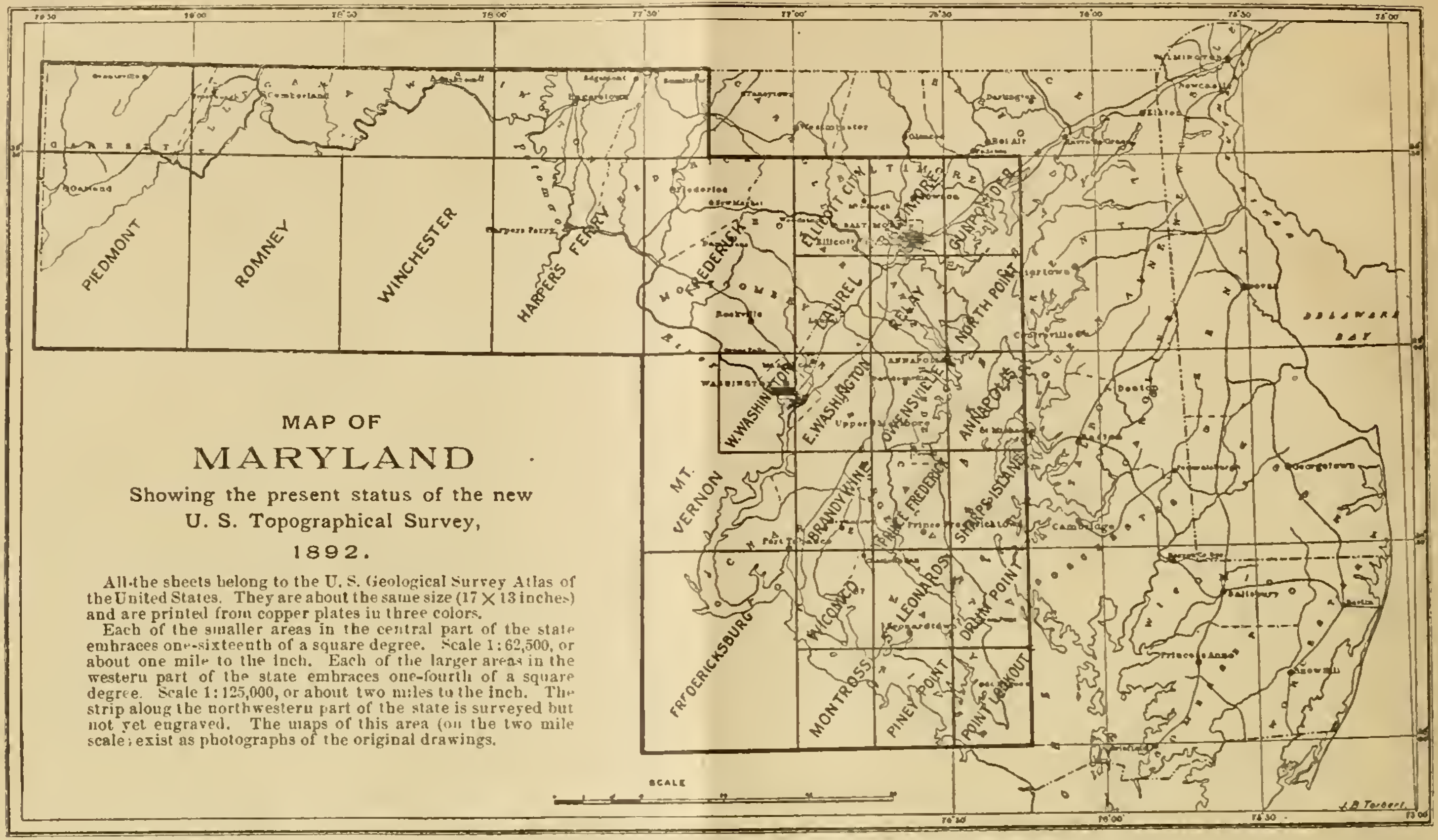
* The copper plate of this interesting map was engraved for Warner and Hanna's Directory of Baltimore, 1801. It now belongs to Lucas Brothers, Stationers, No. 116 E. Baltimore Street, of whom impressions may still be obtained.



MAP OF
MARYLAND
Showing the present status of the new
U. S. Topographical Survey,
1892.

All the sheets belong to the U. S. Geological Survey Atlas of the United States. They are about the same size (17 × 13 inches) and are printed from copper plates in three colors.

Each of the smaller areas in the central part of the state embraces one-sixteenth of a square degree. Scale 1:62,500, or about one mile to the inch. Each of the larger areas in the western part of the state embraces one-fourth of a square degree. Scale 1:125,000, or about two miles to the inch. The strip along the northwestern part of the state is surveyed but not yet engraved. The maps of this area (on the two mile scale) exist as photographs of the original drawings.

drainage basin. This was never published, but has served admirably for lecture purposes.

Within the past year a great variety of representations, both topographical and geological, of all or portions of Maryland's territory have appeared, or have been projected and are now in course of preparation.

The following list of these is intended to show at a glance in what a number of ways our neighborhood has been represented. It may confidently be asserted that no city in the United States has a more varied series of maps and models of its surroundings than Baltimore. This list may be conveniently arranged under three heads:—

Maps, topographical.

U. S. Geological Survey Sheet "Baltimore." Scale 1:62,500, with Baltimore at its centre.

U. S. Geological Survey Atlas Sheet "Baltimore." Scale 1:62,500, with Baltimore near its southern edge.

Johns Hopkins University Topographic Map of Baltimore and Vicinity. Scale 1:62,500, embracing over 400 square miles and comprising all the U. S. Geological Survey Sheet Baltimore and parts of the three contiguous sheets, "Relay," "Laurel," and "Ellicott City." 1892.

Maryland Weather Service Map of the State, drawn in Washington on a scale 1:500,000, and variously reproduced. This gives the boundaries, drainage and principal towns accurately, but has no topography. 1891.

Maps, geological.

The only published geological map of Maryland is the small and imperfect one issued by P. T. Tyson, in his report of 1860, and republished, with slight revision, in Martinet's New Atlas of Maryland, in 1873.

In August, 1891, the U. S. Geological Survey issued a preliminary and imperfect geological map of Washington and Vicinity for the use of the International Congress of Geologists.

In February, 1892, a preliminary edition of the Baltimore Sheet, geologically colored, was issued by the Survey for the use of the American Institute of Mining Engineers. The coloring of this map was, however, unsatisfactory, and the sheet was reissued, greatly improved in appearance, in August, 1892.

In November, 1892, the Johns Hopkins University issued its topographic map, geologically colored. The scheme of colors adopted for this map is quite independent of that in use by the Geological Survey.

A new geological map of the entire State, on a scale of eight miles to the inch, or about 1:500,000, is now in course of preparation for the World's Fair Book on the State's resources. This will be based upon the geological work of Darton, Williams, Keith, Geiger, Tyson, and White.

Models.

Aside from the maps, several relief models have been prepared with the use of the new topographic data. A model of the area of the first Baltimore Sheet, with Baltimore at its centre, was made in 1890 by Mr. Cosmos Mindeleff of Washington, on a scale of four inches to the mile, and with no vertical exaggeration. This model was constructed for the Baltimore Real Estate Exchange, and its cost was met mainly by Mr. H. C. Turnbull, by whom it was copyrighted. It is 5½ feet high by 4½ feet broad and is mounted in a heavy oak frame. As the natural vertical scale of this large model rendered it too flat for the purpose intended by the Real Estate Exchange, it has been deposited at the University, and a second one constructed for the Exchange on the same scale, but with a four-fold vertical exaggeration. This model is a very graphic representation of the region about Baltimore.

A large photograph of the second model is now in course of preparation by Cummins.

A geologically colored replica of this model will be exhibited by the Geological Survey in the Government Building at the Chicago Fair.

The Cumberland Valley Railroad had constructed in Philadelphia a relief model of the North and South Mountains between the Susquehanna and Potomac rivers, to show the valley and the course of its road. The original is deposited at Wilson College, Chambersburg, while photographic reproductions adorn the time-tables of the road. A considerable part of Maryland is represented on this model.

The Maryland Board of Managers for the World's Fair have ordered a large relief model of the entire State. This will measure seven by twelve feet, and is now in course of preparation at Washington by Mr. Cosmos Mindeleff.

NOTES IN GEOLOGY.

Edited by PROFESSOR GEORGE H. WILLIAMS and DR. WILLIAM B. CLARK.

Abstract of a Paper on the Volcanic Rocks of South Mountain in Pennsylvania and Maryland. By GEORGE H. WILLIAMS.[*]

[Printed in full with map, plate and 5 cuts in the *American Journal of Science*, December, 1892.]

[Read before the National Academy of Sciences, November 2, 1892.]

Object of this paper.—It is the object of the present communication to announce the identification of an extensive area of very ancient volcanic rocks which compose an important part of the South Mountain, south of the Susquehanna River. The brief preliminary description of these rocks, which is all that can now be attempted, will, it is hoped, suffice to show that the hitherto accepted theory of their sedimentary origin has been based on a misinterpretation of the facts which they exhibit.

The rocks in question preserve abundant and convincing evidence—both structural, chemical and petrographical—of their original character and genesis. At the same time they show various phases of alteration by recrystallization and dynamic agencies which render them valuable for the study of many problems of metamorphism.

South Mountain rises about fifteen miles west of Harrisburg, and extends, in a great sickle-shaped curve, to the Maryland line. Here it divides into two parts, known as Catoctin Mountain and the Blue Ridge, which diverge at a small angle and enclose the triangular Middletown valley, north of the Potomac.

During the past summer the writer devoted considerable time to mapping the volcanic rocks of this region and to collecting suitable material for laboratory study. This has at present only been fairly entered upon, so that subsequent communications, giving more detailed results, may be expected. As far as is known to the writer, volcanic rocks have not hitherto been definitely described as such in the Appalachians. The rocks here under consideration have long been known to geologists, but they have before, with the exception of a few of the most massive greenstones, been generally regarded as of sedimentary origin.

The cause of the prevailing misconception regarding the volcanic rocks of South Mountain is not difficult to find. Their accompanying accumulations of tuff beds and breccias, and the fact that they are generally cleaved parallel to the great structure-planes of the mountain, have all been readily interpreted as indications of stratification and conformity. The cleavage-dip in the sandstone has often been mistaken for bedding, while the thin jointing and slaty structure of the lavas, though a secondary feature, have seemed to geologists not very familiar with recent volcanic rocks sufficient proof of sedimentary origin.

In spite of great age and some alteration, however, the volcanic rocks of South Mountain have preserved all the essential characteristics of our recent rhyolites and basalts in such perfection that the proofs of their real nature are, to the student of comparative petrography, overwhelming, while to all who will candidly examine them they must be at least convincing.

Petrographical Character.—Approximately 175 square miles of the area of South Mountain is occupied, between Mt. Holly and the head of the Middletown valley, with volcanic rocks. These belong to two types which exhibit sharp contrasts of color, composition and weathering. One type is inclined to tints of red, pink, blue or purple; is acid in composition; generally porphyritic; and weathers into thin slabs. The other type is almost invariably of a green color; basic in composition; frequently amygdaloidal; and weathers into rough, angular blocks. The rocks of the first type have been called felsite, orthofelsite, porphyry, or petrosilex; those of the second, trap, greenstone, chlorite-slate, or epidote-slate. In view, however, of the perfection with which these rocks have preserved the most characteristic features of their modern equivalents, there is no reason why they should not, like them, be termed *rhyolites* and *basalts*. The insignificance of mere age as a factor in rock nomenclature is now so fully recognized that we may with propriety employ the names of our recent lavas for rocks of any geological horizon, when we can prove beyond doubt their identity.

It is, of course, to be expected that many rocks of intermediate character will be found within this volcanic area. Since the petrographical and chemical study has, however, only begun, and since the contrast above noted is so well defined, the distinction of two types may at present be regarded as sufficient.

a). *The acid rocks, rhyolites.*—The rocks of the acid type occupy somewhat more than two-thirds of the volcanic area of South Mountain. They occur in dykes and flows, forming a body of great thickness; they are accompanied by ashes, tuffs and breccias; they are usually porphyritic, though not always so; they exhibit the characteristics of recent glassy and half-glassy rocks—flow-structures, perlitic structure, lithophysae, spherulites (in masses, in layers and in chains), axiolites, pumice, amygdaloids, etc., etc.—in hardly less perfection than the specimens which Professor Iddings has so admirably described from the Yellowstone Park.

These structures are preserved, in spite of the recrystallization of the entire rock substance, into a fine mosaic. They are therefore most apparent in hand specimens, especially when brought out by weathering; or, under the microscope, they are better seen in ordinary than in polarized light, as was the case with the old glass breccia recently described by the writer from the Sudbury region.[*]

The following is an analysis of a rhyolite specimen from the Gladhills Road, near the Bigham Copper Mine, on the north side of Pine Mountain, made by Mr. C. Hanford Henderson, of Philadelphia, and published in 1884.[†] This is a quite typical rhyolite analysis. When compared with analyses of our most recent acid lavas, the iron may seem a little high and the alumina a little low, but on the whole the close agreement is a surprise.

SiO_2	73·62
Al_2O_3	12·22
Fe_2O_3	2·08
FeO	4·03
CaO	0·34
MgO	0·26
Na_2O	3·57
K_2O	2·57
Ign	0·40
Total	99·09

The macroscopic features of the rhyolite are the best proofs of its true nature, for weathering brings out on the surface of the rock each delicate detail. In this way we discover every characteristic of glassy rocks, though there is no glass now remaining.

The microscopical characters of the South Mountain rhyolites are far too varied to be described in a brief paper like the present. It must suffice to say that, in spite of the recrystallization of the substance, we still find in great perfection all the essential features of the most recent acid lavas. Corroded and skeleton phenocrysts of quartz, micropegmatitic intergrowths of quartz in feldspar phenocrysts, and phenocrysts broken by the flow movement. In the groundmass we find spherulitic tufts, axiolites, elongated vesicles filled with quartz, trichites and globulites in great variety, which bring out each detail of flow-structure. All the particulars of microscopic structure call for extended study and description. For the present purpose, however, which is merely to establish the character of these rocks, what has been said must suffice.

In mineralogical composition the South Mountain rhyolites are quite uniform. When phenocrysts are present, the most abundant are alkali feldspar. Quartz in rounded bipyramids is always to be found with the feldspar under the microscope, although it is not so often apparent to the unaided eye. The groundmass of the rhyolites is for the most part a quartz-feldspar mosaic of varying grain, much of which is the result of devitrification and recrystallization, though some of it is also probably original microgranite.

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[*] The writer is under obligations for many of the facts contained in this paper to Miss Florence Bascom, who has mapped in great detail one of the most diversified portions of South Mountain, near Monterey, Pa. She has collected a large material upon which she is now at work at the Johns Hopkins University, and her results, to be published in due time as a thesis, will go far toward furnishing detailed proof of the general conclusions here set forth.

[*] Bull. Geol. Soc. Am., Vol. II, p. 138, 1891. Ann. Rept. Geol. Surv. Can. for 1889–90, F, p. 75, 1891.

[†] "The Copper Deposits of South Mountain," by C. H. Henderson. Trans. Am. Inst. Mining Engineers, Vol. XII, p. 90.

Attention has been called by Tyson,[*] Hunt [†] and Frazer [‡] to the beauty of the South Mountain porphyries, and to the fact that they are so susceptible of a high polish as to make them valuable for decorative purposes. Many of them closely resemble the famous *porfido rosso antico* of Egypt, which is largely used by the lapidaries of Rome.

b). *The basic rocks, basalts.*—The basic lavas of South Mountain occupy an area about one-half as large as that covered by the acid ones. They reach their maximum development near the State line, where, along the southern edge of Pennsylvania and for a considerable distance into Maryland, they form the entire width of the volcanic belt. North and south of this main body, the basic rocks or greenstones are everywhere met with as narrow bands intersecting the rhyolites and following the general trend of the mountain. These bands differ much in their width, but seem to be most developed along the eastern flanks of Green Ridge and Piney Mountain.

These rocks have been more generally sheared into slates than the acid lavas. The chemical alteration which has gone on in them is also in general greater. Still large masses of the basic rocks have been but little altered and remain quite massive. These, which are locally known as "copper rock," are the only members of the volcanic series whose igneous origin has been heretofore conceded. They are for the most part very fine grained, vesicular flows, whose original structure is still so well preserved that they may with propriety be called basalts.

The following analysis, also by Mr. C. H. Henderson, of a massive greenstone from the Bechtel Copper Shaft, Russell Mine, is published by Dr. Frazer.[§] This is a normal basalt analysis, indicating as little chemical change in the basic rocks as the one given above does in the acid rocks.

SiO_2	41·280
Al_2O_3	18·480
Fe_2O_3	9·440
FeO	8·200
CaO	7·040
MgO	7·486
Na_2O	3·523
K_2O	2·208
Ign.	2·740
Total	100·397

Basic volcanic rocks never exhibit so great a variety of structure forms as characterize the more acid rhyolites. The South Mountain basalts are usually homogeneous, dark to pale green masses, which rarely show any microscopical phenocrysts and whose most constant feature is amygdaloidal structure. These cavities vary greatly in size, shape and abundance. They are often elongated by flow-motion in the lava, and are now filled with a number of secondary minerals, the most abundant of which are epidote, chlorite, quartz and zeolites. Traces of original glass or spherulitic structure (variolite) have not yet been detected in the basalts.

The mineral constituents of basic rocks are more subject to alteration than those of acid ones. It could not be expected that basalts so ancient and so vesicular as those of South Mountain would escape all change, but it is a surprise in many cases that this change has been so small. The ferromagnesian constituents have always altered to epidote, chlorite or serpentine, but the structure is frequently preserved in its minutest detail. Under the microscope the ophitic network of feldspar laths is still fresh, and the delicate twinning as distinct as in a recent lava. The form of the basaltic magnetite, of the olivine phenocrysts, and of the interstitial pyroxene is also plainly visible, while the arrangement of the feldspar microliths among the oval vesicles clearly indicates the motion of the still viscous mass.

c). *Pyroclastic deposits, tuffs and breccias.*—As is generally the case with large accumulations of surface eruptions, the South Mountain lavas are accompanied by extensive deposits of pyroclastic material. This includes coarse flow- and tuff-breccias, pumiceous bombs and banded accumulations of fine volcanic ash. Like the massive rocks, this fragmental matter is both acid and basic in composition.

The most striking and important area of acid tuffs covers about a square mile in the Buchanan Valley, at the eastern base of Piney Mountain, two miles north of the Chambersburg turnpike. Here the rock is a breccia whose component fragments vary from two or three feet in diameter to the finest ash. All sizes, shapes and colors are heterogeneously mingled, and the result bears a superficial resemblance to the well-known triassic breccia ("Potomac marble," "calico rock") of the Frederick Valley. The material in this case, instead of being limestone, is entirely rhyolite, and exhibits remarkable variety of structures and colors. Both flow- and tuff-breccias occur here, while a portion of the mass has been sheared into a quite fissile slate. Similar acid tuffs, though of less striking appearance, occur at many other points (Raccoon Creek, Monterey, Old Furnace Road, etc.), and will doubtless continue to be discovered as the examination of the region proceeds.

Fragmental deposits consisting wholly of basaltic material abound along the Western Maryland railroad near Monterey, and farther south. The finer cementing material is in these almost always altered to epidote. It is also not uncommon to find coarse breccias consisting of both the acid and basic types of rock, but a careful search has thus far failed to discover any fragments of sandstone in these pyroclastic beds.

Geological occurrence and relations to the Sandstone.—No evidence is necessary, beyond the petrographical characters above described, to establish the igneous and volcanic nature of the South Mountain rocks. Additional evidence of a purely geological kind is not, however, wanting. The vicissitudes through which these ancient rocks have passed, and their present inadequate exposure, tend to obscure their original relationships. Nevertheless dykes may be seen at various points, especially at the western end of the railroad tunnel on Jack's Mountain, where an amygdaloidal red felsite cuts the massive and schistose greenstones. Further exploration will doubtless bring to light many similar occurrences. Successive flows are not now easy to separate, but the amygdaloidal and fluidal structure of the rocks indicates that they must have been extruded in this form.

The age of the South Mountain volcanics and their relations to the sandstone in which Mr. Walcott has recently identified the lower Cambrian fauna, are points of great interest. The hypothesis of the Pennsylvania geologists that the greenstones and felsites lie above the sandstone is evidently incorrect. It may, however, be regarded as an open question whether the volcanic rocks represent a much older horizon, which was already eroded before the sandstone was deposited, or whether they were, in part at least, contemporaneous with the sandstones.

The entire absence of sandstone as inclusions in the lavas, as well as in all the accumulations of pyroclastic material; the observations of Keith, Geiger and Walcott, that the sandstone lies flat or in syclinals; and the sections made by Miss Bascom across Monterey Peak, Pine Mountain, Jack's Mountain, and Haycock near Monterey, all indicate that the sandstone is altogether above the volcanic rocks, and that it has been only sporadically left by erosion on the east side of the mountain in Pennsylvania. In Maryland the volcanic rocks are flanked both on the east and west by sandstone. No alternations of relatively thin beds of sandstone and lava have thus far been observed. The contacts of the sandstone above the porphyry on the old tapeworm railroad southwest of Maria's Furnace, and above the greenstone in Jack's Mountain railroad tunnel are both admirable exposures, but both seem to be thrust-planes and are not contacts of original deposition.

The South Mountain volcanic rocks therefore become, not merely in their petrographical character and richness in metalic copper, but also in their stratigraphical position, comparable with the Keewenawan or Nipigon series of Lake Superior.

Chemical Alteration and Metamorphism.—Extensive chemical changes, involving devitrification and the formation of new minerals, have gone on in all the volcanic rocks of South Mountain without destroying the original structures. In other cases, where there has been movement and shearing, the same rocks have lost both their original minerals and structures by a process of complete metamorphism. The results are more or less perfectly foliated schists and slates, whose origin can be positively traced to the volcanic rocks, and whose present form can be shown to depend upon the intensity of the dislocation to which they have been subjected.

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[*] First Annual Report, 1860. Appendix, p. 3.

[†] Proc. Am. Assoc. Adv. Science, 1876, p. 212 (compares them with the Elfdalen porphyries).

[‡] Second Geol. Survey of Penn., Vol. CC, p. 285.

[§] "Hypothesis of the Structure of the Copper Belt of South Mountain." Trans. Am. Inst. Min. Engineers, Vol. XII, p. 82, 1883–4.

Comparison with other regions.—The comparative rarity of very ancient volcanic rocks in America as compared with Great Britain[*] and other parts of Europe is doubtless due to their not having been recognized, rather than to their actual absence. The opinions entertained by Hunt of rocks like those of South Mountain have greatly retarded, in this country, the appreciation of their true character. Still they are well known on Lake Superior and in Missouri through the writings of Irving[†] and E. Haworth;[‡] Wadsworth[§] and Diller[‖] have described them in eastern Massachusetts, Shaler[°] in Maine, and the northern continuation of this same belt has been made known by the Canadian geologists, Bailey, Matthew and Ells, in New Brunswick.[¶] Bell has also recently described similar rocks in the Sudbury region.[**]

Similar areas are easily recognizable in Canada and Maine from the writings of Hunt, Jackson and Hitchcock, in spite of the fact that they are not properly interpreted. Volcanic rocks have not before been clearly identified in the Appalachians, but if attention is called to them they will doubtless be recognized at many other points.

A New Machine for Cutting and Grinding Thin Sections of Rocks and Minerals. By GEORGE H. WILLIAMS.

A brief description of a new machine for cutting and grinding rock sections, in which electricity furnishes an economical and satisfactory motive power, may prove acceptable to the constantly increasing number of workers in mineralogy and petrography. This machine was devised for the petrographical laboratory of the Johns Hopkins University over a year ago, and since then it has been in more or less constant use. It has thoroughly established its reputation for accurate and rapid work, while experience has suggested some improvements on the original model.

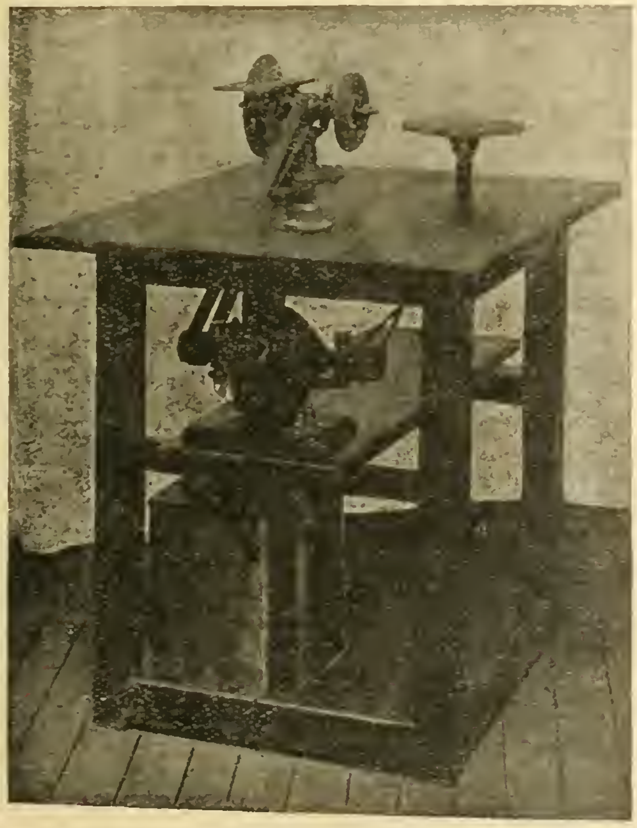

FIG. 1.

The accompanying cut of the machine (fig. 1) hardly needs any explanation. It is seen to consist of a substantial table, carrying in its lower part the electric batteries and motor, while upon its upper surface is placed the apparatus for grinding and sawing.

The table is approximately three and one-half feet square and two feet nine inches high. It is constructed, with all of its appurtenances, by the Donaldson-Macrae Electric Company of 215 N. Calvert St., Baltimore, whose storage batteries and electric motors are well known. The price of the machine complete is $130.00, consisting of the following parts:

1. Three two hundred ampère-hour storage batteries, 13 inches high, in portable rubber cases. These batteries stand on a firmly constructed cross-piece from which they may be readily removed for recharging.

2. One one-eighth horse power electric motor of the Donaldson-Macrae pattern (fig. 2). This is fastened to a second cross-piece above the batteries and below the table surface. It is provided with two pullies from which belts pass to the shafts on the table, which carry the grinding disks and diamond saw.

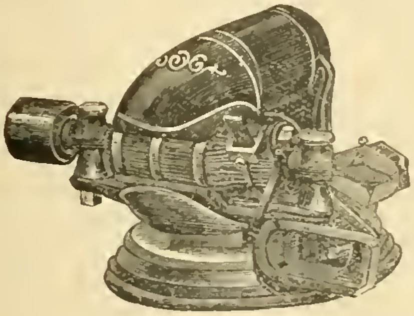

FIG. 2.

3. The grinding apparatus consists of two circular disks of solid copper, 9 inches in diameter and $\frac{3}{8}$ inch thick, which may be used alternately as different grades of emery are required. They are attached either by a screw or square socket to a vertical iron spindle, which revolves smoothly in a conical bearing. The grinding disk is surrounded when in use by a large cylindrical pan of tin (not shown in the cut), which has an opening in its centre to allow of the passage of the spindle.

4. The sawing apparatus consists of a horizontal counter-shaft, placed on a different part of the table from the grinding disk, and connected with the motor by a separate belt. It carries at one end a vertical wheel of solid emery, and at the other an attachment, level-table and guide for the diamond-saw.[*] A small water-can and spout (not shown in the cut) is suspended over the level table to keep the edge of the saw wet when it is in use.

Under some circumstances it may be found advantageous to obtain electricity for this motor by a direct wire from an electric light or power company. Considerable inquiry has, however, shown that in Baltimore the storage batteries are more convenient, safe and economical. A single charging lasts the needs of a laboratory of ten students for a month. The batteries are removed by the electric company and returned with little or no delay at a cost of $3.75 for recharging.

Note on Quartz-Bearing Gabbro in Maryland. By ULYSSES SHERMAN GRANT.

In the description of the gabbros of the region around Baltimore[†] the normal type was found to be a pure hypersthene gabbro, or hyperite, with very few accessory minerals and not a trace of original quartz in any facies of the rock. However, several specimens of a quartz-bearing phase of this gabbro have been recently discovered. These occurrences are of special interest when considered in connection with the extensive development of quartz in the gabbros to the northeast of Baltimore, near Wilmington, Delaware;[‡] and at the suggestion of Prof. Williams the following note has been prepared.

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[*] Sir A. Geikie: Anniversary Address, Quart. Jour. Geol. Soc., Vols. XLVII and XLVIII, 1891–1892.

[†] Monographs U. S. Geol. Survey, V, 1883; and Bulletin, No. 62, 1890.

[‡] Am. Geologist, Vol. I, p. 280, 1888, and Bull. Missouri Geol. Survey, No. 5.

[§] Bull. Mus. Compar. Zool Cambridge, Vol. V, No. 13, p. 282.

[‖] Ibid., Vol. VII, No. 2, 1881.

[°] Am. Jour. of Science (III), Vol. XXXII, p. 40, 1886. Ann. Rep. U. S. Geol. Surv., Vol. VIII, p. 1043, 1889.

[¶] Ann. Rep. Can. Geol. Surv., 1877–8 DD, and 1879–80 D.

[**] Ibid., for 1889–90 F, 1891.

[*] Admirable saws—circular tin disks 8 inches in diameter, with one inch center aperture, whose edge is provided with diamond dust secured by cement,—may be had of Wm. Kerr, No. 292 Westminster St., Providence, R. I., for $12.00 per half dozen.

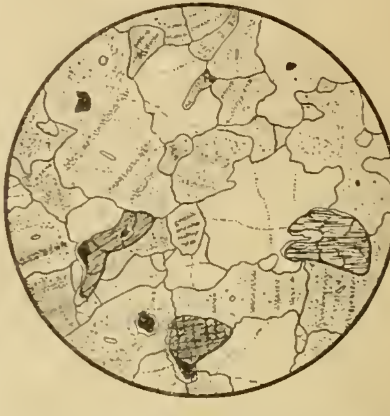
[†] G. H. Williams: The Gabbros and Associated Hornblende Rocks Occurring in the Neighborhood of Baltimore, Md.; Bull. U. S. Geol. Survey No. 28, 1886.

[‡] F. D. Chester: The Gabbros and Associated Rocks in Delaware; Bull. U. S. Geol. Survey No. 59, 1890.

The first locality where quartz gabbro was noticed in Maryland is in Harford County, just north of Priest's Ford bridge over Deer Creek, on the road to Darlington. Here, and in the immediate vicinity, Prof. Williams in 1886 found this facies of gabbro quite common. The rock is of medium grain and the quartz is in large irregular grains, which vary in color from blue to milky white. Under the microscope the rock is seen to have been more or less highly altered; most of the pyroxene has changed to green hornblende, the plagioclase is breaking down, and the large quartzes show decided undulatory extinction and often fissuring. In the decaying plagioclase are many small limpid areas of quartz, to all appearances of secondary origin; these do not, as a rule, show any signs of undulatory extinction. The large areas of quartz are clouded by innumerable dust-like inclusions similar to those described in the plagioclase of the Baltimore gabbro.[*] On account of the altered character of the rock, it would be unsafe to draw any positive conclusions as to the primary nature of these large quartz grains, although they certainly seem to be original and similar to the quartzes found in the Baltimore gabbro (to be mentioned below); and, concerning these last, there appears to be very good evidence for considering them as original constituents of the rock. The quartz gabbro of the Baltimore area is very fresh and unaltered, and for this reason it will be treated more in detail.

Thus far quartz gabbro has been seen at only one locality in the Baltimore area. The first specimen was found in the high wall of the Mt. Hope Asylum by Mr. Wm. S. Hunnell in 1890, who noticed but one boulder of this facies of the rock, and this showed macroscopic grains of quartz over only a part of its surface. Another similar loose block was found by the writer on the road connecting the Reisterstown turnpike with the Mt. Hope railway station. Both of these blocks are remarkably fresh, and have evidently not been moved far from their original location; in all probability they came from the cut of the Western Maryland railway just north of Mt. Hope station. These specimens present macroscopically the appearance of the typical unaltered hypersthene gabbro common to this locality, except that here and there are seen limpid blue quartz grains, sometimes with a diameter of nearly a quarter of an inch. These grains are not, as a rule, scattered through the rock at approximately equal distances from each other, but are collected in certain irregular and illy defined areas, which at first suggest a secondary origin, as though the quartz has been deposited in small cavities formed by the fissuring of the rock or by the disappearance of certain other mineral grains. Microscopically the rock is seen to be a granular aggregate of rather medium grain, consisting of plagioclase (bytownite), quartz and hypersthene, with accessory magnetite, apatite and very little hornblende, which is all of a secondary nature. The plagioclase, hypersthene and hornblende, which occurs only in narrow rims around the hypersthene and magnetite, have already been exhaustively described,[†] and so need not be further mentioned here. The mineral of interest is the quartz, which in the eight slides examined makes up from one-tenth to one-third of the whole rock. It is easily distinguished in ordinary light from the plagioclase in the sections by its limpid appearance, as the plagioclase is darkened and clouded by innumerable microscopic inclusions, probably of magnetite, which, however, are greatly diminished in quantity around the borders of the grains and in the vicinity of the larger inclusions of apatite and magnetite. The quartz, on the other hand, contains very few of these inclusions and rarely holds grains of magnetite. As is usual in granitic quartz, the grains are often crossed by irregular lines of small liquid cavities, which when magnified are seen to be irregularly oval or circular in outline, but some have the form of negative crystals, which are usually bipyramidal, although in a few cases the prism and pyramid are in about equal development. Bubbles are seldom seen in these cavities. Very rarely the quartz contains fine needles, probably of rutile, although this could not be definitely determined, for under the highest powers the needles still appear as very minute, opaque rods. As before stated, the quartz in the hand specimens has a decidedly blue color; this is also the case in fragments of quartz detached from the rock and in thin sections when viewed by reflected light. Reusch[‡] has shown that the blue color in certain Norwegian quartzytes is due to inclusions and small particles of magnetite between the grains; but this cannot be the reason for the coloration of the quartz of the Baltimore gabbro. In fact, no cause for this color can be detected under the microscope, as the mineral is unusually free from inclusions; nor does it appear to be colored by any dilute pigment, but is entirely clear and transparent in transmitted light.

From a macroscopic examination of the rock the primary nature of the quartz appears rather doubtful, but under the microscope it is seen to possess all the original characteristics shown by the other minerals. The structure of the rock is typically granitic,—the quartz, plagioclase and hypersthene being completely allotriomorphic,—as may be seen in the figure. This strongly indicates the original character of the quartz. There are two ways by which the quartz could be accounted for, if of secondary origin. First, it might be due to a replacement of certain minerals by silica,—a partial silicification of the gabbro. This is a common occurrence in certain gabbros, but in this case there appears to be no evidence of any such replacement; all the constituents present a fresh and unaltered appearance and sharp outlines; and such silicification of eruptive rocks is not known to occur in this neighborhood. Second, the quartz could have been deposited in small cavities formed by a fracturing of the rock. If this were the case, we should expect the rock to show decidedly cataclastic structures, as the cracking and fracturing of the different grains and periferal granulation of the same; but such is not the case. The only evidence of dynamic action in the rock is shown by the more or less marked undulatory extinction of some of the quartz grains,—which, of course, must have been caused by pressure acting after the quartz was formed,—accompanied in a few cases by very slight fissuring; but in no case has the action been intense enough to produce periferal granulation of the grains. So it seems impossible to consider the quartz as anything but an original constituent of the rock.



Section of Quartz Norite from Mt. Hope, Baltimore Co, Md ×30.

The areas filled with minute dots (dust-like inclusions) represent plagioclase; the clear areas often crossed by rows of dots (cavities) represent quartz; the areas with dark outlines and crossed by numerous lines (cleavage cracks) represent hypersthene; magnetite is shown in solid black, and the clear partial borders around the hypersthene and one magnetite grain represent secondary hornblende; the small clear prisms in the plagioclase are apatite crystals.

None of the sections from Mt. Hope contain any diallage, although the normal specimens of the Baltimore gabbro show both diallage and hypersthene; nor are there in the rock any areas of secondary hornblende which might have originated from diallage, the rock being exceedingly fresh and unaltered and very little secondary hornblende having been formed. In fact the only amphibole seen in the sections is confined to very narrow green rims partially surrounding some of the hypersthene and magnetite grains. Thus, while the normal type of the Baltimore gabbro is a true *hypersthene gabbro* or *hyperite*, the quartz-bearing facies of it is a *quartz norite*.

Sections cut from parts of the blocks found at Mt. Hope, in which no trace of quartz could be seen with the unaided eye, showed under the microscope considerable quantities of this mineral in fine particles. Further examination may show that the quartz is disseminated in microscopic grains in other portions of the Baltimore gabbro area, although a large number of thin sections from other parts of this area have been studied and no trace of this mineral was found.

The occurrence of quartz in gabbro as an unimportant accessory mineral is not very unusual, but it seldom comes to be an essential constituent of this rock over any large area. This, however, is the case in the gabbro around Wilmington, Delaware, where quartz is decidedly abundant and universally present.[*] Here the acid gabbro is found to grade into what have been termed "gabbro granites."[†] Towards the southwest, in Harford County, Md., quartz is not nearly as common in the gabbro; but in places it becomes quite abundant, and Professor Williams has here found this facies of the rock grading into augite granites. Still farther southwest is the Baltimore gabbro area where quartz must be regarded as an extremely rare accessory mineral and its occurrence may be considered as very sporadic. It is true in all probability that the gabbros of Delaware and Maryland, while not connected at the present surface, are of like age and are genetically the same. In this connection it is of interest to note the gradual increase of the basic character of the rock-mass from Wilmington towards Baltimore.

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[*] Bull. U. S. Geol. Survey No. 28, p. 21.

[†] Ibid., pp. 19-24.

[‡] Neues Jahrbuch f. Min. Geol. u. Pal., 1883, II, p. 180.

[*] Bull. U. S. Geol. Survey No. 59, p. 8.

[†] Ibid., p. 19.

Notes of Minerals recently obtained from the Quarries of Jones' Falls. By S. L. Powell.

Since the publication of "Notes on the Minerals occurring in the neighborhood of Baltimore," by Dr. G. H. Williams, in 1887, and an appendix to this, "Contributions to the Mineralogy of Maryland," by Dr. Williams and A. C. Gill, in 1889, published in this *Circular*, No. 75, the quarries at Jones' Falls have been in active operation. And owing to the fact that they have been carefully watched by the students of the University, unusually fine specimens of the minerals occurring there have been obtained. As this communication is intended as an appendix to the papers named above, in which the majority of the minerals of this locality are described, mention will be made of only such matter as may be new or of special interest. The minerals siderite, haydenite, stilbite, and laumontite, are of frequent occurrence, and have all been found in well developed crystals. They, however, offer nothing worthy of note beyond what has already been described. Apatite, barite, orthoclase, mica (muscovite), epidote, occur sparingly, and frequently well crystallized.

The minerals of this locality occur in two distinct associations: the one in druses and pockets in the gneiss, due to local alteration, and the other in veins of coarse pegmatite penetrating the gneiss.

Calcite has long been observed in the form of Iceland spar, but not in crystals until recently. Two cavities were found in the gneiss containing well defined transparent crystals, showing the prisms of the first and second orders in combination with the rhombohedron and basal plane. They are from two to four millimeters in diameter, and from five to thirteen millimeters in length. The carbonates range from pure calcium carbonate (Iceland spar) on the one hand to carbonate of iron (siderite) on the other. *Ankerite*, a subspecies intermediate between calcite, magnesite and siderite, occurs in semi-transparent rhombohedrons, and globular forms, built up of sub-individuals, frequently passing into beautiful saddle-shaped forms, some of which attain to an inch in diameter. It occurs in druses associated with the zeolites.

Perfectly developed crystals of muscovite and orthoclase have recently been found in pockets in the gneiss, associated with siderite, calcite and laumontite. The *muscovite* occurs in sharply defined hexagonal plates, with well developed prismatic planes. They are from three to ten millimeters in diameter. They sometimes have a green coating, in which are imbedded minute crystals of pyrite. The *orthoclase* occurs in short, stout, white, opaque crystals, showing the forms: 001, 010, 110, 101. Heretofore these two minerals have not been observed to occur in association with the zeolites.

The crystals of *beaumontite* so far surpass any previously found in the perfection of their planes, that measurements were made upon them. In the following table the averages of a number of independent measurements of corresponding angles made upon the most perfect crystal are given and compared with the angles of heulandite. The position and lettering of the planes are those of E. S. Dana, instead of those of vom Rath used in the former description of this species in the "Notes on Baltimore Minerals." While these angles vary considerably from those formerly obtained by Gill and Burton, the measurements agreed so closely among themselves that we must conclude that the angles of beaumontite are subject to wide variation.

	Beaumontite.	*Heulandite.*
$201:\bar{2}01$ ($t\,s$)	130° 37′ 22″	129° 40′
$110:1\bar{1}0$ ($m\,m$)	134° 50′ 10″	136° 04′
$110:010$ ($m\,b$)	114° 27′	111° 58′
$201:001$ ($t\,c$)	117° 56′ 40″	116° 20′

The second mode of occurrence of specimens of mineralogical interest at the Jones' Falls Quarries is as constituents of the coarse pegmatite veins or dykes, which form a characteristic member of the Baltimore gneiss series. Microcline, albite, quartz, lepidomelane, muscovite, garnet, black tourmaline and apatite are the common original minerals in these veins.

In April 1892 a pegmatite vein was exposed which exhibited three varieties of feldspar in sharp contrast. One of these was the usual flesh-colored microcline; the second, a dark grayish green feldspar having also the appearance of microcline, while the third was a white striated feldspar resembling albite. These three feldspars were analyzed by Mr. W. F. Hillebrand of the U. S. Geological Survey with the following results:

	I.	II.	III.
SiO_2	65.06	68.48	63.72
Al_2O_3	18.41	16.11	22.26
Fe_2O_3	——	0.20	——
FeO	——	0.17	——
CaO	0.26	0.23	3.58
BaO	0.13	0.05	——
MgO	0.04	0.03	0.06
Na_2O	1.60	1.27	8.98
K_2O	14.30	12.99	0.76
H_2O below 100° C.	0.04	0.06	0.09
H_2O above 100° C.	0.26	0.26	0.43
	100.10	90.85	99.88

I. is the flesh-colored microcline.

II. is the green microcline; its only difference in composition is its small percentage of iron. Its higher percentage of SiO_2, causing a lower percentage of other constituents, is due to the associated quartz not having been completely separated.

III. is an albite-oligoclase, having the composition Ab : An : : 4 : 1.

The two microclines were seen in some crystals to merge gradually into one another. The green color may be due to secondary infiltration of some iron salt.

The *albite-oligoclase* is peculiarly interesting on account of showing highly developed twinning striations on both the basal and brachypinacoidal cleavage faces. The former are exactly parallel to the cleavage and are due to the ordinary albite law; the latter are produced by the pericline law, the composition face being the rhombic section which in this case is inclined 10½° in a positive direction to the basal cleavage. This angle was measured on sections cut parallel to the brachypinacoid. Polysynthetic twinning according to the pericline law has recently been shown by Penfield and Sperry to occur in many cases where it has before been overlooked. (*Am. Journal of Science*, Vol. 34, November, 1887, p. 390.) The albite-oligoclase of Jones' Falls furnishes an addition to the list of occurrences given by these authors.

The mica of the coarse pegmatite veins encloses large red *garnets* of the icositetrahedral type, which show a well marked parting or cleavage parallel to the faces of the rhombic dodecahedron. This feature manifests itself in striations parallel to the longer diagonal of the faces of the icositetrahedron, which in some specimens is so marked that the faces of the rhombic dodecahedron appear to have developed into a pyramid by the addition of successively smaller plates, the result of which is to form the icositetrahedron. These garnets appear in all respects to be like those from Arendal in Norway described by O. Mügge. (N. J. B., 1889, Vol. I, p. 239.)

One of these pegmatitic veins was observed which has undergone complete alteration, resulting in a large development of calcite and chlorite, together with a considerable amount of epidote. The tourmaline, contained in the pegmatite, remains imbedded in the calcite and chlorite. The alteration appears to be due to the action of water, as larger veins of pegmatite in the same quarry, through which water is seen to percolate, exhibit a tendency to the same process of alteration. The calcite encloses large flakes of dark brown mica, penetrating it in every direction, and which is but slightly altered. Where these flakes of mica pass from the calcite into the chlorite, or occur altogether in the chlorite, they are very much altered, breaking down into chlorite and calcite. The chlorite is the variety to which Volger gave the name *Helminth*. It is light green in color and occurs in small hexagonal plates, which arrange themselves in rosettes, fan-shaped, and vermicular forms of great variety. The crystals of tourmaline, mentioned above, vary from microscopic dimensions to four inches in length. They are considerably bent and broken, and are imbedded in the chlorite in such a manner as to show that the bending occurred previous to the alteration of the pegmatite. Cross-sections of the crystals show a zonal structure with a light blue centre, an intermediate zone of very dark blue, and an exterior one of dark olive brown, shading into gray on the margin. The epidote occurs in compact granular masses and in highly developed crystals, intermingled with the calcite and chlorite.

The Eocene of the United States.* By William B. Clark.

The publication of a series of Correlation Essays upon the geological formations of the United States has been inaugurated by the Director of the U. S. Geological Survey, and already several reports have appeared while others are in press or in preparation. A special division of the Geological Survey has been established to superintend the work, and is known as the Division of Geologic Correlation. Professor G. K. Gilbert was appointed chief of this Division and will prepare a general essay on the principles of correlation. The reports that have already appeared are the Cambrian, by Professor C. D. Walcott; the Devonian and Carboniferous, by Professor H. S. Williams; the Cretaceous, by Dr. C. A. White; and the Neocene, by Dr. W. H. Dall and G. D. Harris.

The report prepared by the writer deals with the Eocene of the United States. Upon stratigraphical and geographical grounds it is considered under three divisions:

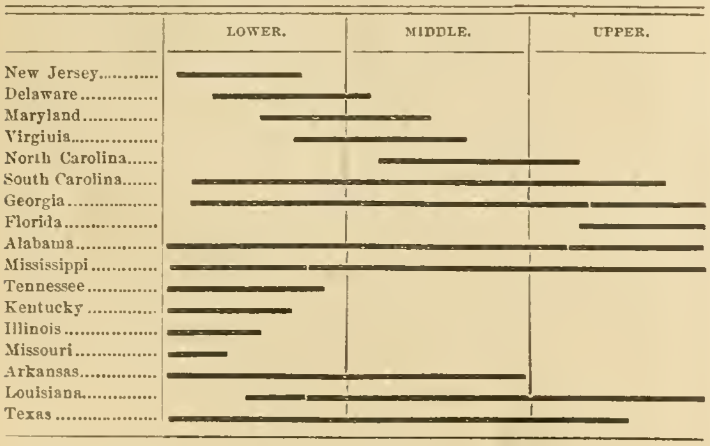
The Atlantic and Gulf Coast Region.
The Pacific Coast Region.
The Interior Region.

Under each head there is an historical sketch in which a full review of the literature occurs, followed by a detailed discussion of the stratigraphical and palæontological characteristics of the various formations in the several districts. In each instance, at the close of the descriptive portion, an attempt is made to correlate the deposits of the different portions of each district with one another and with similar deposits in the other districts and in foreign lands. Wide correlations of the deposits are, however, deprecated on the ground of inadequate knowledge of the strata, which does not admit of satisfactory comparisons even within narrow limits.

For important reasons the deposits of each district are discussed in different ways, those of the Atlantic and Gulf Coast Region by States, while those of the Pacific Coast and Interior Regions are treated by formations. In the former instance the writers have been so numerous and have so commonly considered the deposits of each State independently, that the stratigraphy can best be treated by political districts, although such division of the strata is not warranted on geological grounds. In the case of the Pacific Coast and Interior Regions the investigations have not usually been conducted with reference to the political boundaries, so that in general less confusion exists as to the views of geologists upon the stratigraphy.

Atlantic and Gulf Coast Region.—The Eocene of the Atlantic and Gulf Coast Region extends as a narrow band, with occasional breaks, from New Jersey to Texas, and holds a nearly central position in the Coastal Plain. Upon stratigraphical and palæontological grounds it is divided into Lower, Middle, and Upper members, although it is often difficult to refer local deposits to a definite position in this series.

The following table will show the geological range of the Eocene in the several States:



The lithological and palæontological characteristics of the deposits vary greatly in the different portions of the Atlantic and Gulf Coast Region. It is probable, however, that many of the differences will become much less pronounced, even if they do not entirely disappear, upon a fuller understanding of the strata and their fossils. On account of these marked differences in deposits and organic remains, it seems essential to the writer to provisionally establish the four following provinces, viz.: New Jersey Province, Maryland-Virginia Province, Carolina-Georgia Province, and Gulf Province.

The New Jersey Province contains a fauna that has few, if any, forms in common with other Eocene areas. It is closely related to the underlying Cretaceous in the character of its sediments.

The Maryland-Virginia Province has some species of fossils in common with the more southern Eocene areas, but the majority are distinctive of the region. Its deposits are almost exclusively greensand, and although probably representing in part Lower and Middle Eocene, are hardly as old as the New Jersey strata, with which they have evidently no forms in common.

The Carolina-Georgia Province has a much fuller representation of the entire Eocene series, a more extensive fauna and a greater variety in its deposits. It is more closely related to the Gulf Province, which it approaches in many particulars.

The Gulf Province, extending from Florida to Texas and including the Mississippi embayment, presents certain characteristic features that separate it, both lithologically and palæontologically, from the Atlantic Coast provinces. The wide development of lignitic strata throughout the Gulf Province must have required peculiar conditions for their accumulation that did not exist along the Atlantic Coast. Moreover, these conditions were not confined exclusively to the earlier stages of the Eocene, although there predominating, but frequently recurred throughout the entire period.

The *Lower Eocene* of the Gulf Province, commonly known as the Lignitic, attains great prominence, and in the region of the Mississippi embayment reaches its most marked development. In its geographical extent it is the leading member of the Eocene. It becomes much less lignitic in the eastern portion of the region than in the central and western; its faunal characteristics are there more marine and the beds more calcareous.

The *Middle Eocene* in its two divisions, the Buhrstone and Claiborne, presents a characteristic series of deposits that acquire their most marked individuality in the State of Alabama, where a varied fauna characterizes the upper of the two horizons.

The *Upper Eocene*, with its widely developed White Limestone beds, affords a sharp contrast to the other members of the Eocene series. In the western portion of the area the White Limestone, so typically developed in Alabama, is frequently interstratified with beds of arenaceous deposits containing bands of lignite.

The fauna of the various horizons of the Eocene in the Gulf States is vastly richer than on the Atlantic Coast, and affords many species that do not exist in the latter region.

As an appendix to the Atlantic and Gulf Coast Region, the Brandon Formation is discussed and doubt expressed as to the contemporaneous origin of all the lignitic deposits that have been so classed. In short, the Eocene age of any of the strata is called in question.

Pacific Coast Region.—Concerning the Eocene of the Pacific Coast, relatively little is known at the present time. Its occurrence at a number of points in California, Oregon and Washington has been established, but its boundaries have never been traced.

Two phases have been recognized,—one marine, the other brackish-water in character. The former is known as the Tejon Group, having been so named by Prof. J. D. Whitney from Fort Tejon, California, near which point strata of Eocene age were early found. The latter is called the Puget Group by Dr. C. A. White, from its occurrence near Puget Sound, Washington.

The Tejon Group has been recognized in California, Oregon and Washington. It is conformable to the underlying Chico group, which has a decidedly Cretaceous fauna, including numerous characteristic ammonitic and lamellibranchiate types. Although some of the fossils of the Tejon are identical with the Chico and indicate Cretaceous conditions, yet the majority are different, some specifically identical with Eocene species from other localities. Deposition was undoubtedly continuous during the Chico-Tejon period, and as the conditions changed but slightly, certain forms continued to live on from Cretaceous into Eocene time. Most geologists agree to-day as to the Cretaceous age of the Chico and the Eocene age of the Tejon. The Tejon is in turn conformably overlain by the Miocene, but still less is known in regard to the latter than the former on the Pacific Coast.

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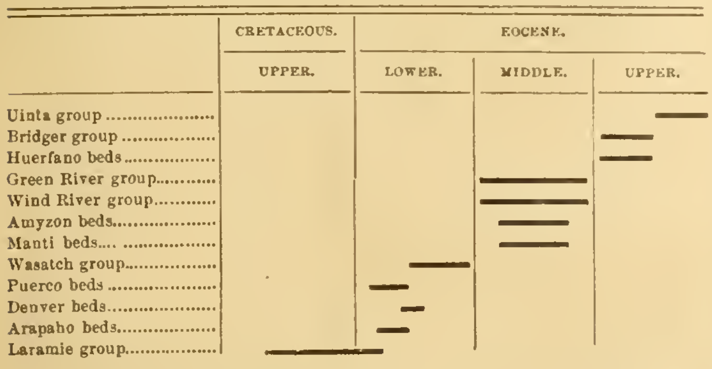
*Correlation Papers—Eocene. By William Bullock Clark. Bulletin 83, U. S. Geological Survey. 173 pp., 2 maps. Washington, 1892.

The Puget Group has only been recognized in Washington, where it occurs of great thickness in the Puget Sound Basin and in the Cascade Mountains. The deposits are brackish-water in origin, so that the faunal relations of the Tejon and Puget groups cannot be determined, and at the same time nothing is apparently known of their stratigraphical relations. A few species of fossil plants have been considered identical with forms from the Laramie Formation of the Interior and the Lignitic of the Gulf, so that the Eocene age of the Puget group is held to be established.

Interior Region.—The Eocene of the Interior region covers an extensive area on the eastern and western flanks of the Rocky Mountains. Though largely found in broad, continuous tracts, it not infrequently occurs in narrowly circumscribed basins that extend from Colorado on the east to Nevada on the west, and from Montana on the north to Texas on the south. Within these limits similar conditions largely prevailed. From an open sea of Cretaceous age, in which the life was marine, a gradual change took place to great fresh water lakes in which the typical Tertiary deposits of the Interior were accumulated. Although the marine and fresh-water divisions present marked palæontological differences, they are still linked together by a series of brackish-water deposits that afford many points for comparison with both the older and younger horizons. Whether these intervening beds should be referred to the Cretaceous or the Eocene, or considered to represent portions of each, has been widely discussed, and no problem in American geology has perhaps furnished so extensive a literature. It is the opinion of the writer that these deposits, collectively known under the name of the Laramie group, should be referred partly to the Cretaceous, partly to the Eocene, although an investigation of the deposits has thus far failed to reveal any satisfactory evidence as to the exact position of the dividing line. The Laramie strata contain sandstones, shales and lignites that indicate the shallow-water conditions which prevailed during their formation. It has been generally held that most of the lignitic strata of the Interior are of approximately identical age, and by many the Laramie group has been made to include them all. Certain local deposits have been thought by some to be of very different age, viz.: the Fort Union beds have been considered Tertiary, though perhaps synchronous with a part of the Laramie series; the Bear River Estuary beds are held to be earlier than the oldest Laramie, while the Arapaho and Denver beds are considered later.

The other members of the Interior Eocene are all fresh-water deposits, and their position in the series will be shown in the accompanying table.



It is impossible in this short review to enter into a description of each group. The most typical section of the fresh-water Eocene series is found in the vicinity of the Uinta Mountains, where the strata of the Wasatch, Green River, Bridger and Uinta groups are found in conformable sequence.

The report contains a map of the United States, upon which is shown the distribution of the Eocene in the several regions. A bibliographic list of the important articles and special treatises upon Eocene stratigraphy closes the paper.

The Mesozoic Echinodermata of the United States.*

By WILLIAM B. CLARK.

The need of a systematic study of American fossils is nowhere more apparent than among the Echinodermata. Almost nothing is known of the Mesozoic and Cenozoic representatives of this class, the publications being few in number and widely scattered, some in fact wholly inaccessible to the general student of palæontology.

The present report is intended as an exhaustive treatment of the Mesozoic Echinodermata, and already much work has been done toward the completion of the report upon the Cenozoic representatives of the same class.

Not alone new species, but old as well, are fully described and figured. Fifty plates of illustrations accompany the text, and altogether there are 420 figures.

Nearly all the species described from the Jurassic are new, as are also about one-half from the Cretaceous. Many of the old forms were so imperfectly described and figured, that in some instances it has been very difficult to distinguish them with certainty.

Most of the available material in the country has been studied, including that from the U. S. National Museum, Philadelphia Academy of Natural Sciences, American Museum of Natural History, New York, Boston Society of Natural History, Texas Geological Survey, and many private collections, the most important of which is that of Professor R. T. Hill.

The following is the list of species, with their geological horizons:

Uintacrinus socialis Grinnell.
Cretaceous (Niobrara Group); Utah, Kansas.

Bourgueticrinus alabamensis de Loriol.
Cretaceous (Ripley Formation); Alabama.

Pentacrinus asteriscus Meek and Hayden.
Jurassic; Dakota, Montana, Colorado, Idaho.

Pentacrinus Bryani Gabb.
Cretaceous (Middle Marl Bed); New Jersey.

Pentacrinus Whitei Clark.
Triassic (?), Jurassic; Nevada, Utah.

Ophioglypha bridgerensis (Meek).
Cretaceous; Montana.

Goniaster mammillata Gabb.
Cretaceous (Middle Marl Bed); New Jersey.

Asterias dubium Whitfield.
Jurassic; Dakota.

Cidaris splendens (Morton).
Cretaceous (Middle Marl Bed); New Jersey.

Cidaris Walcotti Clark.
Cretaceous (Middle Marl Bed); New Jersey.

Cidaris texanus Clark.
Cretaceous (Washita Formation of Comanche Series); Texas.

Cidaris taylorensis Clark.
Jurassic; California.

Cidaris californicus Clark.
Jurassic; California.

Leiocidarus hemigranosus (Shumard).
Cretaceous (Washita Formation of Comanche Series); Texas.

Salenia texana Credner.
Cretaceous (Washita Formation of Comanche Series); Texas.

Salenia tumidula Clark.
Cretaceous (Middle Marl Bed); New Jersey.

Salenia bellula Clark.
Cretaceous (Middle Marl Bed); New Jersey.

Hemicidaris intumescens Clark.
Jurassic; California.

Pseudodiadema diatretum (Morton).
Cretaceous (Middle Marl Bed); New Jersey.

Pseudodiadema texanum (Roemer).
Cretaceous (Fredericksburg Formation of Comanche Series); Texas.

Diplopodia texanum (Roemer).
Cretaceous (Fredericksburg Formation of Comanche Series); Texas.

Diplopodia Hilli (Clark).
Cretaceous (Austin Chalk); Texas.

Coptosoma Mortoni (de Loriol).
Cretaceous (Rotten Limestone); Mississippi.

Coptosoma speciosum Clark.
Cretaceous (Middle Marl Bed); New Jersey.

Goniopygus Zitteli Clark.
Cretaceous (Fredericksburg Formation of Comanche Series); Texas.

Psammechinus cingulatus Clark.
Cretaceous (Middle Marl Bed); New Jersey.

Pedinopsis Pondi Clark.
Cretaceous (Austin Chalk); Texas.

Stomechinus Hyatti Clark.
Jurassic; California.

Holectypus planatus Roemer.
Cretaceous (Washita Formation of Comanche Series); Texas.

Pyrina Parryi Hall.
Cretaceous (Washita Formation of Comanche Series); Texas.

Botriopygus alabamensis Clark.
Cretaceous (Ripley Formation); Alabama.

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* The Mesozoic Echinodermata of the United States. By William Bullock Clark. Bulletin 97, U. S. Geological Survey (in press.) Washington, 1893.

Echinobrissus expansus Clark.
Cretaceous (Ripley Formation); Alabama.
Echinobrissus texanus Clark.
Cretaceous (Austin Chalk); Texas.
Trematopygus crucifer (Morton).
Cretaceous (Middle Marl Bed); New Jersey.
Catopygus oviformis Conrad.
Cretaceous (Middle Marl Bed); New Jersey.
Catopygus pusillus Clark.
Cretaceous (Lower Marl Bed); New Jersey.
Cassidulus florealis (Morton).
Cretaceous (Lower Marl Bed); New Jersey.
Cassidulus aequoreus Morton.
Cretaceous (Ripley Formation); Alabama.
Cassidulus micrococcus Gabb.
Cretaceous (Ripley Formation); Alabama.
Cassidulus subquadratus Conrad.
Cretaceous (Ripley Formation); Mississippi.
Cassidulus subconicus Clark.
Cretaceous (Ripley Formation); Mississippi.
Cassidulus porrectus Clark.
Cretaceous (Ripley Formation); Alabama.
Cassidulus Stantoni Clark.
Cretaceous (Colorado Group); Colorado.
Ananchytes ovalis Clark.
Cretaceous (Middle Marl Bed); New Jersey.
Cardiaster cinctus (Morton).
Cretaceous (Middle Marl Bed); New Jersey.
Holaster simplex Shumard.
Cretaceous (Washita Formation of Comanche Series); Texas, Indian Ter.
Enallaster texanus (Roemer).
Cretaceous (Fredericksburg Formation of Comanche Series); Texas.
Enallaster obliquatus Clark.
Cretaceous (Fredericksburg Formation of Comanche Series); Texas.
Epiaster elegans (Shumard).
Cretaceous (Washita Formation of Comanche Series); Texas.
Epiaster Whitei Clark.
Cretaceous (Washita Formation of Comanche Series); Texas.
Hemiaster parastatus (Morton).
Cretaceous (Middle Marl Bed and Ripley Formation); New Jersey, Ala.
Hemiaster stella (Morton).
Cretaceous (Middle Marl Bed); New Jersey.
Hemiaster ungula (Morton).
Cretaceous (Middle Marl Bed); New Jersey.
Hemiaster texanus Roemer.
Cretaceous (Austin Chalk); Texas.
Hemiaster Humphreysanus Meek and Hayden.
Cretaceous (Fort Pierre Group); Montana.
Hemiaster Dalli Clark.
Cretaceous (Washita Formation of Comanche Series); Texas.
Hemiaster californicus Clark.
Cretaceous (Shasta Group); California.
Hemiaster Calvini Clark.
Cretaceous (Shoal Creek Limestone of Comanche Series); Texas.
Linthia tumidula Clark.
Cretaceous (Middle Marl Bed); New Jersey.

It will be observed that one species is referred to the Triassic, seven to the Jurassic, sixteen to the Lower Cretaceous, and thirty-six to the Upper Cretaceous.

At some horizons of the Atlantic and Gulf Coast Cretaceous, the Echinodermata are important type fossils, but they are generally few in individuals as well as in species.

Recent Additions to the Paleontological Museum.

By H. S. Gane.

Some five years ago the nucleus of the present paleontological collection of the Johns Hopkins University was made from the deposits of the Atlantic Coastal Plain by Dr. Wm. B. Clark, who was able, at the time, to gather together a very large amount of material, owing to the richness of the formations in fossils and their accessibility to the city of Baltimore. Since that time, additions have been made each year by collection and by exchange with the National and State Surveys, and educational institutions.

The present year has afforded a greater increase to the fossil collections than any preceding one. This was accomplished mainly by exchange and purchase, although a considerable amount of material was collected in the field. Among the principal additions may be mentioned the following:

Zittel Collection: A very important addition to the museum is one of some two hundred and sixty-five different species received from Professor Karl von Zittel of the University of Munich, who, by selecting the material more from a zoölogical than a geographical standpoint, prepared a collection especially adapted to the needs of the student in paleontology. It is particularly rich in foranimifera, bryozoa and sponges, the latter of which is one of Professor Zittel's specialities, and many of the specimens illustrate the different genera and species as described by him. Besides the three groups mentioned above, the remaining fossils are mostly representatives of the echinoderm, lamellibranch, gasteropod, ammonite, and crustacean groups. There are also some forty specimens of the celebrated Solenhofen slates, a number of which are the very finest cabinet specimens. This collection, while nominally an exchange, was practically a gift on the part of Professor Zittel to the Paleontological Museum of the University.

Krantz Collection: This collection of fossils was purchased by the University from Dr. Krantz, of Bonn, Germany. It includes specimens from the Paleozoic, Mesozoic, and Cenozoic of Europe. It is especially rich in the Cretaceous, both as to the number of localities and variety in the forms represented. There are also a great number of species of Mesozoic and Cenozoic corals and echinoderms which are of inestimable value for comparison with similar American forms from the same geological horizons With especial reference to teaching purposes, there have been included a large number of microscopic preparations to illustrate the structure of fossil organisms.

Harris Collection: Mr. George F. Harris of the British Museum, has given the University a collection in exchange that is very rich in Tertiary fossils, illustrating many of the typical English localities. The collection is a large and representative one, containing many hundred species from the Eocene, Oligocene and Pliocene of England.

Owing to the fact that the richest and finest collections of the Paleontological Museum of the Johns Hopkins University are from the American Tertiary, these English Tertiary fossils are of the highest interest and usefulness to a student of geology at the University.

Collections made in the field: Recently a large number of specimens from Claiborne, the famous Eocene locality of Alabama, have been worked out of the rough material. Of these there has been carefully prepared and determined a great number of different species, which will be valuable for future reference and comparison of Eocene fossils either from Alabama or any other part of the Gulf or Atlantic Coastal Plain.

There was also added to the collections of Eocene fossils of Maryland, a number of new and rare forms from Ft. Washington on the Potomac river, that were not heretofore found in the University collections.

Several trips into southern Maryland and Virginia were made by different members of the geological department for fossil collecting. The type localities of Conrad were visited, and between a hundred and a hundred and fifty Miocene forms obtained. These have been identified with care and are now on exhibition in the Museum, and can be used by students of the University for comparison and determination of private collections.

MARYLAND STATE WEATHER SERVICE. REPORT OF PROGRESS.

By William B. Clark.

The following statement submitted to the President of the University, and published in his annual report, will afford a brief account of the progress of the State Weather Service during the past year. The data have been furnished by Dr. C. P. Cronk, the meteorologist in charge.

Although the Maryland State Weather Service was organized in May, 1891, under the joint auspices of the Johns Hopkins University, the Maryland Agricultural College and the U. S. Weather Bureau, results of its work during the remaining months of that year were meagre and incomplete, as there was no fund available for the publication of reports.

The University had given the services of one of its Faculty as Director, besides office room for the accommodation of the central station of the system; the Agricultural College had given the services of one of its Faculty as Secretary and Treasurer; the U. S. Weather Bureau had given the services of a Meteorologist in charge, increased the force of the central station by the addition of two assistants, furnished nearly all of the voluntary observing stations with instruments, all of them with the necessary forms, stationery and franked envelopes, and more than one hundred individuals, representing the different sections of the territory embraced by the Service, volunteered as meteorological observers, crop reporters, or displaymen.

It remained for the State, for the benefit of which the service was established, to supply the sum needed for the publication of reports. A bill was drafted, introduced at the last session of the Legislature by Senator Gorter, and signed by the Governor. It reads as follows:

An Act to Establish a State Weather Service, and to Make an Appropriation Therefor.

Section 1. Be it enacted by the General Assembly of Maryland, That there is hereby established a State Weather Service, which shall be under the control and management of the Johns Hopkins University, the Maryland Agricultural College and the United States Weather Bureau; the officers of said service shall be a Director, designated by the President of the Johns Hopkins University, a Secretary and Treasurer, designated by the President of the Maryland Agricultural College, and a Meteorologist in Charge, designated by the Chief of the United States Weather Bureau; they shall be commissioned by the Governor, and be duly qualified as officers of the State; the said officers shall constitute a Board of Government, under the direction of the institutions from which they are appointed, and shall receive no compensation for their services as such officers.

Sec. 2. The central station and office of said Service shall be at the Johns Hopkins University; the Board of Governors shall establish, if practicable, one or more voluntary meteorological stations in each county in the State, and supervise the same, co-operating with the Chief of the United States Weather Bureau for the suitable location of such stations, in order that the greatest usefulness may result to the State and National services; the said officers are authorized to print weekly and monthly reports of the results and operations of said Service, and to distribute the same in such a manner as they shall deem most serviceable to the people of the State.

Sec. 3. The sum of two thousand dollars* annually, or so much thereof as shall be necessary, is hereby appropriated out of any funds of the Treasury not otherwise appropriated, for the purpose of carrying out the provisions of this Act, to be paid to said officers, or to their order, by the Treasurer, upon the warrant of the Comptroller, and upon the vouchers of said officers; provided, however, that no part of said sum shall be paid for salaries for any officer or officers, but a reasonable compensation may be paid for printing and other necessary and proper expenses of said officers.

Sec. 4. The said officers shall report to the Legislature at its regular sessions their expenditures under the provisions of this Act, and such information as said officers may deem desirable, or as the Legislature may require.

Sec. 5. And be it further enacted, That this Act shall take effect from the date of its passage.

Approved April 7, 1892.

In the securing of the enactment of the law establishing the Service, too high an estimate cannot be placed upon the interest and zeal displayed by many prominent citizens of the State. Special mention should be made of the names of Messrs. John C. Legg, Harry F. Turner, Louis Müller and Lloyd L. Jackson. Without the support of these gentlemen the needed legislation would have failed and Maryland would be without that which the most sparsely settled territory of the United States does not lack. Every State and Territory of the Union is now included within a State Weather service.

The work of the Maryland State Weather Service is similar to that carried on by like services in other States. The voluntary observers of the State organization are also observers of the National Bureau, and the results of each observer's work are tabulated monthly in the Monthly Weather Review, published in Washington under the direction of the Chief of the Weather Bureau.

The publication of each State Service is chiefly devoted to a discussion of the climate of the territory covered by its observations, the effect of the meteorological conditions upon the products of the soil, and the special advantages to be enjoyed by the inhabitants.

The Board of Control of the Maryland Service has reason to be satisfied with the results accomplished. On account of the varied climate of Maryland, the difference in its soil formation, and its extensive coast-line, the agricultural and commercial interests of the State are important and many. The charts of monthly temperature and rainfall beautifully exhibit, in the curves of the isotherms and the distribution of the rainfall, the influence of the bay in the east and the mountains in the west, and open vistas of future usefulness to the State.

The sum appropriated by the State Government, though small, has enabled the printing of monthly reports, extending throughout the year, and of weekly reports, extending throughout the growing and harvesting seasons. That these reports are appreciated by the people of the State is evidenced from the hearty support they have given in rendering reports of the weather and of the crops, and by the general and complete publication of reports by the newspapers of the State. Two thousand copies of each of the monthly reports and about five hundred copies of each of the weekly reports have been distributed. They are sent to the meteorological observers of the Service (who for the most part are agriculturists), into other States, and to prominent institutions. A few copies are sent abroad. It is intended to add to the list of foreign institutions receiving the reports.

During the year meteorological reports have been received from thirty stations in Maryland, the District of Columbia and Delaware (the territory covered by the service), and crop reports have been received from sixty reporters, principally agriculturists. There are, also, thirty weather signal display stations attached to the service.

During the past year the central office in the physical laboratory of this University has been designated as a station of the first class, and is being fully equipped with the latest improvements in the barograph, thermograph, sunshine recorder and other self-registering instruments. Telegraphic reports in cipher, to avoid numerals and unnecessary expense, are received each morning from about 140 stations throughout the United States. These reports include atmospheric pressure, temperature (exposed, and maximum and minimum), direction and velocity of wind, state of weather, precipitation, dew-point, clouds, and any special phenomena which may be necessary. These reports are platted upon a map dotted with the location of the stations; isotherms and isobars are drawn, and forecasts are made after a consideration of the general and local conditions. The general forecast received from Washington is also circulated. Though the Washington weather map (which doubtless is the most complete and finished map of the kind made in any country) is received, posted and circulated in Baltimore, a large blackboard weather map from which the local forecast is made is drawn at the Corn and Flour Exchange under the supervision of Dr. Cronk, the Meteorologist in charge of the State Service. The observations throughout the United States and Canada are taken at 8 A. M., 75th meridian time, and the map is usually completed before 10 A. M. The precedence of Weather Bureau business over other telegraphic matter accounts for the early receipt of the messages.

Chief-Assistant Wilson and Assistants White and Brewer have rendered valuable aid in the preparation of reports.

The approbation of the President of the University in the work done, the kindness of Professor Rowland in providing convenient and comfortable office rooms for the central station, the encouraging support of Professor Williams, and the generous help of Mr. Murray, to whose advice the attractive form of the monthly report is due, are gratefully acknowledged.

THE ANNUAL EXPEDITION OF THE STUDENTS IN GEOLOGY, 1892.

By William B. Clark.

During the last five years annual geological expeditions have been conducted by the writer into those portions of the Coastal Plain bordering the Middle Atlantic slope. In this manner extensive areas in Maryland, Virginia and New Jersey have been visited and large collections of fossils and rocks brought back by those who have taken part.

The expeditions were primarily undertaken as part of the work of the geological department, but other persons were invited to participate, so that often those from outside exceeded in number the members of the University. Representatives of other educational institutions, including both teachers and students, as well as members of the scientific bureaus in Washington, have availed themselves of the opportunities that have been thus afforded.

On account of the inadequate means of transportation and accommodation in the regions visited, the expeditions, previous to the present one, have always been made by boat. A schooner or steamboat suitable for the accommodation of the party was arranged for, and, since the country is deeply indented by tidal estuaries, most points could be approached by water. The expedition of 1891 was made upon vessels of the Maryland Oyster Navy, under the authorization of the Board of Public Works, and was participated in by twenty-five persons, representing the University and other institutions. The objective point of this expedition was Southern Maryland.

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* The Governor signed the bill on the condition that only $1000 of this appropriation should be used annually.

This last year it was deemed advisable to visit, in part, areas that could not be reached by water, so that the usual means of travel were abandoned. Longer time was spent at stated points and special provision made for the same. Two widely distant portions of the Coastal Plain were visited: 1st, the basin of the York and James Rivers, Virginia, and 2d, Eastern New Jersey.

Virginia Expedition.—Arrangements were made in advance by which permanent accommodations were obtained at Yorktown for the entire party. From this point the highly fossiliferous Miocene deposits exposed in the banks of the York and James Rivers were visited. The long bluff below Yorktown was carefully examined and large collections made from the various horizons. The section* found here is recorded in the account of an earlier expedition to the same point. The bluff had been extensively cut into by the waves since the previous visit, and the beach was strewn with the washed out Miocene shells.

Above Yorktown the bluff at Bellefield is very rich in Miocene fossils, and some time was occupied in collecting at this point. Many other localities were visited, both above and below Yorktown.

From Yorktown an excursion was made across the isthmus to Carter's Grove, near Grove Wharf, on the James River, which affords one of the richest collecting points in the Virginia Miocene. There is practically no limit to the amount of material that can be there obtained. The section† of the bluff at this point was given in an earlier report.

Nothing older than the Miocene was examined on this expedition, and very little was collected from any other horizon.

New Jersey Expedition.—Special arrangements were made with the railroads and hotels so that satisfactory rates and accommodations were provided for in advance. The afternoon and night of the first day were spent in Philadelphia, where an opportunity was given to examine the Museum of the Philadelphia Academy of Natural Sciences, which contains large collections of New Jersey fossils, including many of the types of Morton, Conrad, Gabb and others who early described the rich fauna of the Greensand marls.

Early the second day the party went to Vincentown, where collections were made from the Upper Marl Bed, in which extensive pits have been dug, as well as from the limestone horizon of the Middle Marl Bed, which affords numerous remains of Bryozoa and Echinodermata. Later Birmingham was visited, and near the dam across Rancocas Creek, as well as in the large pits beyond, the Terebratula layer of the Middle Marl Bed was found. The pits are chiefly opened in the Greensand layer beneath.

The third day was passed in New Egypt and vicinity, where an opportunity was given to collect from the very fosiliferous marl pits of the Lower Marl Bed below the town on Crosswick's Creek, as well as from the *Gryphaea vesicularis* and *Terebratula Harlani* layers of the Middle Marl Bed. Some distance above New Egypt the Upper Marl Bed is found with characteristic fossils.

On the morning of the fourth day the party went to Perth Amboy, where they examined numerous clay and sand pits of the Raritan formation in the vicinity and along the highway to Woodbridge. The glacial deposits of the region also received attention. From Woodbridge the train was taken to South Amboy, from which place the section along the railroad to Keyport was examined during the afternoon. The sands of the upper portion of the Raritan formation which pass gradually through alternating layers of sand and clay into the stiff clay deposits of the Clay Marls were observed beyond South Amboy. In the great excavations opposite Keyport thin seams of greensand were found interstratified with the clays.

The fifth and sixth days were passed in the Navesink Highlands at Atlantic Highlands and vicinity. There is a grand section on the bluff facing the Raritan Bay, of Clay Marls, Lower Marl Bed and Red Sand. The Lower Marl Bed is here rich in fossils, and great numbers were collected by the party. Extensive land-slides have taken place, so that the Red Sand is at several points carried down to the level of the water.

Upon the New Jersey expedition the leading divisions of the Cretaceous were seen and a large number of fossils collected from the most important localities in the State.

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* See *University Circulars*, No. 81, p. 71.

† See *University Circulars*, No. 81, p. 71.

THE ANNUAL EXPEDITION OF THE STUDENTS IN GEOLOGY, 1893.

By George H. Williams.

Announcement.

Until last year it has been customary to offer each year to the Geological Students of the University, and to others from a distance desiring to take part in them, two geological excursions of some length. One of these was designed for the examination of the later formations of the Coastal Plain in New Jersey, Maryland or Virginia, and the other for the study of the more ancient and folded strata of the Appalachians. Experience has, however, shown that each of these regions offers too much to be satisfactorily examined if the time available in one season is divided between them. It has therefore been deemed advisable to arrange these two extended excursions for alternate years, and thus to secure for each a longer time than would otherwise be possible.

A brief account of the trip made last spring into the Tertiary and Cretaceous formations of Virginia and New Jersey is given above by Professor Clark. During the coming spring it is proposed to take an excursion of similar length (ten days) across the Piedmont Plateau and Appalachians. The exact date of this trip cannot now be definitely fixed, but it will probably be between May 20th and June 10th. The route will also be subject to revision, but the general plan is to go by the Western Maryland Railroad from Baltimore to Monterey, Pa., for the examination of the ancient volcanics and Cambrian sandstones of South Mountain; thence by the same road to Chambersburg, above which, at Raccoon Creek and Caledonia Furnace, the volcanic rocks exhibit their most interesting features. From Chambersburg it is proposed to cross the Cumberland Valley to Cherry Run on the Potomac, and to examine there the great fault between the upper and lower Silurian strata. Above this place the section of Silurian and Devonian beds exposed near Hancock will be visited, whence the party will proceed by train (B. & O. R. R.) to Cumberland. This place offers unrivalled opportunity for a study of the Paleozoic sequence from the base of the Medina to the top of the Upper Coal measures within the limits of a day's walk.

On the return journey down the Potomac an opportunity will be offered to study the Blue Ridge between Harper's Ferry and Point of Rocks, especially the relation of the granite to the green schists of the Middletown valley.

Any persons desiring to participate in this excursion can obtain further particulars by applying to the writer. It is desirable to know the entire number of those going at least ten days before the start is made.

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